PB89-206213

Superfund Record of Decision (EPA Region 5): Mason County Landfill Mason County, Michigan (First Remedial Action) September 1988

(U.S.) Environmental Protection Agency, Washington, DC

28 Sep 88

U.S. Department of Commerce
National Technical Information Service
NTIS

50272-101

REPORT DOCUMENTATION PAGE

1. REPORT NO. EPA/ROD/R05-88/080

2.

3. Recipient's Accession No. PB89 206213/AS

4. Title and Subtitle
SUPERFUND RECORD OF DECISION
Mason County Landfill, MI
First Remedial Action

5. Report Date 09/28/88

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G)

12. Sponsoring Organization Name and Address
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

13. Type of Report & Period Covered 800/000

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

The Mason County Landfill site is located three miles south of the City of Ludington, Mason County, Michigan. The site occupies approximately 18 acres of a predominantly rural area in Pere Marquette Township. Approximately 10 acres of the site were used as a landfill. Less than 500 feet from the landfill there is a wetland area which drains into Babbin Pond, the headwaters of Iris Creek. There are 14 residential wells within a 0.5 mile radius of the landfill. The population within a 3-mile radius of the site is estimated to be 1,112. The Mason County Department of Public Works (DPW) leased the property in 1971 and entered into an agreement with Acme Disposal, Inc. to operate the site as a sanitary landfill. Although the Michigan Department of Natural Resources (MDNR) documented that slurry and sludge wastes from local industries were being dumped at the landfill, the site's license was renewed annually until it was closed in August 1978 after reaching capacity. Public concerns over the water quality in Iris Creek prompted the DPW and MDNR to review closure activities. The site is currently owned by Mason County as result of a settlement with two property owners who filed suit against the county. In 1983, a clay cap was installed over the landfill and berms and storm drains were constructed to improve site drainage. Two surface aerators were installed in Babbin Pond to facilitate biodegradation of organic matter and 15 gas vents were (See Attached Sheet)

17. Document Analysis a. Descriptors
Record of Decision
Mason County Landfill, MI
First Remedial Action
Contaminated Media: gw
Key Contaminants: VOCs (benzene, PCE, TCE, xylene)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement

19. Security Class (This Report) None

20. Security Class (This Page) None

21. No. of Pages 115

22. Price

(See ANSI-Z39.18) *See Instructions on Reverse*

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

EPA/ROD/R05-88/080
Mason County Landfill, MI
First Remedial Action

16. ABSTRACT (continued)

placed in the top of the landfill. The site has been separated into two operable units; one for the landfill contents and one for the ground water. This source control remedial action addresses the landfill contents. Contamination of the shallow and deep aquifer will be addressed in a subsequent remedial action. Site investigations indicate that contamination of surface water, surface sediment, soil, and offsite air quality are not sufficient to warrant remedial action. The primary contaminants of concern affecting the ground water are VOCs including benzene, PCE, TCE, and xylene.

The selected remedial action for this site includes: construction of a RCRA cap over the landfill; access restrictions; deed restrictions on and near the site to prohibit use of the shallow aquifer; and ground water monitoring. The estimated present worth cost for this remedial action is $2,800,000, with present worth O&M costs of $1,000,000 over 30 years.

United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R05-88/080
September 1988

PB89-206213

EPA

Superfund Record of Decision:

Mason County Landfill, MI

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RECORD OF DECISION

SELECTED INTERIM REMEDIAL ALTERNATIVE

Site Name and Location

Mason County Landfill
Mason County, Michigan

Statement of Basis and Purpose

This decision document presents the selected interim remedial action for the Mason County Landfill, in Mason County, Michigan, developed in accordance with CERCLA, as amended by SARA, and to the extent practicable, the National Contingency Plan. This decision is based on the administrative record for this site. The attached index identifies the items that comprise the administrative record upon which the selection of the remedial action is based.

The State of Michigan has concurred with the selected remedy. The letter of concurrence is attached to the Record of Decision package.

Description of the Selected Remedy

The selected remedy is an operable unit that will address the landfill contents portion of the site by properly capping the landfill. The operable unit that will directly address the groundwater contamination and other off-site contamination, or potential contamination, shall be addressed after more investigation is done, including the assessment of the effectiveness of the new landfill cap. The selected remedy is considered cost effective and is consistent with the eventual final remedy. The specific components of the selected remedy include:

- a RCRA subtitle C compliant soil/clay cap,
- a fence around the site,
- deed restrictions on and near the site to prohibit use of the shallow aquifer, and
- continued monitoring to apply towards the groundwater operable unit and to monitor the effectiveness of the new cap.

Declaration

The selected remedy is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for this site. Because treatment of the principal threats of the site was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy.

Because this remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

9/28/88

Date

Valdas V. Adamkus

Valdas V. Adamkus
Regional Administrator

MASON COUNTY, MICHIGAN

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Letter to Ethel Lister, Clerk Pere Market Township, re lab analysis of waste confirming it is industrial waste.	Prein & Newhaf	75/11/26	2
Letter to Arthur L. Sherman answering questions on Mason County Landfill	Bureau of Envrnmtal Protection	76/11/05	2
To Mason Cty Dept Public Works: Concludes Phase I of landfill program and includes recommendations for Phase II and a segment of Phase III work	William & Works	81/10/06	83
: Ann Sause, Ecology & Environment, Inc. Letter encloses memo re public comment on landfill	FWGottshalk, Dept Ntrl Resrs	82/05/13	2
Potential Hazardous Waste Site Site Inspection Report	EPA	82/05/25	14
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to RWhippo - USEPA re: Mason County Landfill RI Existing Data Analysis Task ED	SMcBee - CH2M HILL	86/04/18	52

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MASON COUNTY, MICHIGAN

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DRAFT: Phase I RI Technical Report	CH2M HILL	87/06/05	268

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TITLE	AUTHOR	DATE
Standard Operating Safety Guide Manual		
Guidance on Remedial Investigations Under CERCLA		
Delegation of Remedy Selection to Regions		
Guidance on Feasibility Studies Under CERCLA		
Superfund Public Health Evaluation Manual		
MOU Between the ATSDR and EPA		
erim Guidlines and Specs for Preparing QAPPs (QAMS-005/80)		80/12/29
Users Guide to the USEPA Contract Laboratory Program		82/08/00
Interim Standard Operating Safety Guides		82/09/00
Superfund Community Relations Policy	WHedman	83/05/12
Community Relations in Superfund: Handbook		83/09/00
Community Relations in Superfund: A Handbook		83/09/00
Guidance Memorandum on Use and Issuance of Administrative Orders Under Section 106 of CERCLA		83/03/08
Interim CERCLA Settlement Policy		84/00/00
LA Compliance with other ironmental Statutes		85/02/12

ADMINISTRATIVE RECORD INDEX-UPDATE
MASON COUNTY LANDFILL
MASON COUNTY, MICHIGAN

CHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE
	6	85/08/05	Request to PRP that they voluntarily undertake actions necessary to abate or prevent the release of hazardous substances.	Kerry Weiss - USEPA	Acme Disposal Co.	Correspondence
	2	85/08/20	Response to 8/5/85 Notice Letter.	J.Kozba-atty.for Ed&Christine Dains	John Oaks-USEPA	Correspondence
	2	85/08/22	Response to USEPA letter of 8/5/85 and an objection to being considered a PRP in this matter.	Clay Olmstead-Mason Co.	John Oaks-USEPA	Correspondence
	1	85/08/23	Letter requesting a response to a letter sent 8/5/85 requesting that the PRP participate in an RI/FS.	Frank Rollins-USEPA	Harbison-Walker Refractor	Correspondence
	1	85/08/23	Request that the PRP respond to letter of 8/5/85 requetsing that they participate in an RI/FS.	Frank Rollins-USEPA	The County of Mason,MI.	Correspondence
	1	85/08/25	Letter requesting a response to the USEPA letter of 8/5/85 which requested a response on their willingness to conduct or participate in an RI/FS.	Frank Rollins-USEPA	Acme Disposal Co.	Correspondence
	1	85/08/26	Letter declining to participate in an RI/FS.	J.Kozba-atty. for Ed Dains	Frank Rollins-USEPA	Correspondence
	1	85/08/28	Invitation to attend a meeting to be held on 9/6/85.	Frank Rollins-USEPA	Clay Olmstead-Mason Co.	Correspondence
	1	85/08/29	Invitation to PRP to participate in a meeting to be held on 9/6/85.	Frank Rollins-USEPA	L.Dendooyer-Harbison Walker	Correspondence
	118	85/09/06	Response to Information	Harbison-Walker Refractories	Frank Rollins-USEPA	Correspondence

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MASON COUNTY LANDFILL
MASON COUNTY, MICHIGAN

HE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE
			Request.			
	1	85/12/04	PRP declines to participate in an RI/FS.	R.R.Crawford-Harbison Walker Refrac	Janet Haff-USEPA	Correspondence
	4	88/06/20	General Notice Letter to PRP's informing them of the location of documents prepared to date and the repository for these documents.	Mary Gade - USEPA	See service list	Correspondence
	4	87/12/00	Fact Sheet " Remedial Investigation Update Mason County Landfill Site".	USEPA		Fact Sheet
	83	81/10/06	Report concluding Phase I of the Mason County Pere Marquette landfill program and includes recommendations for Phase II and a segment of Phase III work.	William & Works	T.Hansen-Mason Co. DPW	Reports/Studies
	19	82/07/26	Hazard Ranking System Scoring Package.	D.Sewall-Ecol. & Envir.	USEPA	Reports/Studies
	5	83/01/27	Preliminary Assessment	Ecology & Environment	USEPA	Reports/Studies
	14	86/02/27	Site Safety Plan For Field Investigations.	Shara McBee-CH2M Hill	Bob Whippo-USEPA	Reports/Studies
	359	86/10/23	Quality Assurance Project Plan (QAPP).	CH2M Hill	USEPA	Reports/Studies
	35	87/06/05	Work Plan Phase II Remedial Investigation/ Feasability Study	CH2M Hill	USEPA	Reports/Studies
	426	87/08/25	Quality Assurance Project Plan (QAPP) Phase II.	CH2M Hill	USEPA	Reports/Studies
	244	88/02/24	Final Phase I Remedial Investigation Technical Report.	CH2M Hill	USEPA	Reports/Studies

ADMINISTRATIVE RECORD SAMPLING/DATA INDEX
MASON COUNTY LANDFILL, MASON COUNTY MICHIGAN
DOCUMENTS NOT COPIED. MAY BE REVIEWED AT THE
USEPA REGION V OFFICES, CHICAGO, ILLINOIS.

DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE
82/06/30	Review and data package for EPA cata set no. SF1658. SMO traffic no. ME 8787 to ME 8782.	Chuck Elly - USEPA	B.Bartholomew-Ecol & Env.	Sampling/Data
82/07/13	Review and data package for EPA data set no. SF1658, SMO traffic no. E1446 to E1448; E1624 to E 1447.	Chuck Ely - USEPA	Bob Bartholmew-Ecol.&Env.	Sampling/Data
82/07/19	Review and data package for EPA data set no. SF1658, SMO traffic no. E1626.	Chuck Eily-USEPA	B.Bartholomew-Ecol. &Env.	Sampling/Data
86/12/18	Review and data package for EPA data set no. SF3579, SMO traffic no. E01-E015.	Patrick Churilla-USEPA	CH2M Hill	Sampling/Data
86/12/22	Review and data package of EPA data set no. SF3595 SMO tarffic no. E01-E012	Jay Thakker-USEPA	CH2M Hill	Sampling/Data
87/01/05	Review and data package of EPA data set no. SF3594 SMO Traffic no. MEC731-739; MEB899-910; MEC234-240; MEB369-368.	Jay Thakker-USEPA	CH2M Hill	Sampling/Data
87/01/05	Review and data package: USEPA data set no. SF3594 , SMO Traffic no. EA421-450; EB512.	Patrick Churilla-USEPA	CH2M Hill	Sampling/Data
88/01/21	Review and data package for EPA data set no. SF4742: SMO traffic no. MEK414-428, 319,321,328-330:MEI799; MEB679,996.998,999.	Curtis Ross-USEPA	CH2M Hill&B.Whippo-USEPA	Sampling/Data
88/02/03	Review and data package of EPA data set no. SF4751: SMO traffic no. MEK435-441, 446-463.	Curtis Ross-USEPA	CH2M Hill&B.Whippo-USEPA	Sampling/Data
88/02/09	Review and data package for EPA data set no. SF4743:	cURTIS rOSS-usepa	CH2M Hill&B.Whippo-USEPA	Sampling/Data

ADMINISTRATIVE RECORD SAMPLING/DATA INDEX
MASON COUNTY LANDFILL, MASON COUNTY MICHIGAN
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DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE
	SMO traffic no. ME8678,680, 695,697-700,793,794,997,; MEI661,796,800;MEK302,322-327, 412,413,429-434,442-445,464;ME F396.			
88/02/12	Review and data package for EPA data set no. SF4739: SMO traffic no. EN161-175.	Patrick Churillo-USEPA	CH2M Hill&B.Whippo-USEPA	Sampling/Data
88/02/22	Review and data package of EPA data set no.SF4740: SMO traffic no. EJ262-263; ER076-82,084-086,EL198,200, 457,458,441,569,571,579.	Patrick Churillo-USEPA	CH2M Hill&B.Whippo-USEPA	Sampling/Data
88/02/25	Review and data package for EPA data set no. SF4743: SMO traffic no. EN087-094, 176-182.	Patrick Churillo-USEPA	CH2M Hill&B.Whippo-USEPA	Sampling/Data
88/03/01	Review and data package of EPA data set no. SF4747: SMO traffic no. E75-E82.	Patrick Churillo-USEPA	CH2M Hill&B.Whippo-USEPA	Sampling/Data
88/03/02	Review and data package for EPA data set no. SF4741; SMO case no. 8708; SMO traffic no. EL459-461,463-468,470,570, 572-578; EJ264-266,348-355; EK751-752;EL197,199,456.	Patrick Churilla-USEPA	CH2M Hill&B.Whippo-USEPA	Sampling/Data
88/03/14	Review and data package for EPA data set no. SF4744: SMO traffic no. EK753;EQ101, 102,159-161;ER095-100.	Patrick Churillo-USEPA	CH2M Hill&B.Whippo-USEPA	Sampling/Data
88/03/18	Review and data package for EPA data set SF4738: SMO traffic no. E01-E32.	Jay Thakker-USEPA	CH2M Hill&B.Whippo-USEPA	Sampling/Data
88/03/25	Review and data package for EPA data set no. SF4746: SMO traffic no. MEK465-471; MEM444-446,443,501.	Jay Thakker-USEPA	CH2M Hill&B.Whippo-USEPA	Sampling/Data
88/03/28	Review and data package for EPA data set no. SF4747: SMO traffic no. E33-E51.	Patrick Churillo-USEPA	CH2M Hill&B.Whippo-USEPA	Sampling/Data

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ADMINISTRATIVE RECORD SAMPLING/DATA INDEX
MASON COUNTY LANDFILL, MASON COUNTY MICHIGAN

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DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE
	E53-E73.			
88/04/05	Review and data package of EPA data set no. SF4746: SMO traffic no. #EK465-471; #EM444-446,443,501.	Jay Thakker-USEPA	CH2M Hill&B.Whippo-USEPA	Sampling/Data
88/04/06	Review and data package of EPA data set no. SF4910: SMO traffic no.(illegible).	Winston Vijjeswarapu-USEPA	CDM & Dan Cozza-USEPA	Sampling/Data

MASON COUNTY LANDFILL, MASON COUNTY, MICHIGAN
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Guidance on Feasibility Studies Under CERCLA		
Superfund Public Health Evaluation Manual		
MOU between the ATSDR and EPA		
Interim Guidelines and Specs for Preparing QAPPs (QAMS-005/80)		80/12/29
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Guidance Memorandum on Use and Issuance of Administrative Orders Under Section 106 of CERCLA		83/09/08
Interim CERCLA Settlement Policy		84/00/00
CERCLA Compliance with other vironmental Statutes		85/02/12

ADMINISTRATIVE RECORD INDEX UPDATE NO. 2
MASON COUNTY LANDFILL
MASON COUNTY, MICHIGAN

FICHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE
	2	85/08/16	Author declines to participate in the RI/FS.	Julia Hagen-Vermont American Corp.	John Oaks-USEPA	Correspondence
	2	85/12/04	Letter informing the USEPA that the authors are not interested in participating in the investigations or studies.	R.Crawford-Harbison Walker Refract.	Janet Haff - USEPA	Correspondence
	2	88/08/19	Letter commenting on proposed plan.	Gustafson, area resident	Croce, USEPA	Correspondence
	11	88/08/24	PRP notice letter	Kelley for Gade, USEPA	PRPs	Correspondence
	2	88/08/24	Letter commenting on the RI/FS and Proposed Plan.	Pere Marquette Twnship. Bd.	Croce, USEPA	Correspondence
	1	88/08/25	Letter from counsel for Mr. Ed Dains informing the USEPA that he is not interested or willing to participate in the RI/FS.	James J. Kobza	Frank Rollings-USEPA	Correspondence
	2	88/08/29	Letter confirming phone conversation the prior week re: private property concerns.	Rasch, area resident	Croce, USEPA	Correspondence
	3	88/08/29	Letter commenting on draft RI/FS	Pacific, US Dept. of Interior	Cozza, USEPA	Correspondence
	3	88/08/30	Letter commenting on EPA's ROD	Treup, atty. for Mason Cty.	Cozza & Radell, USEPA	Correspondence
	4	88/08/31	Letter responding to PRP notice letter and commenting on the RI/FS and the Remedial Action Plan	Davis, atty. for PRP Straits Steel	Croce, USEPA	Correspondence
	7	88/08/31	Letter commenting on RI/FS and Proposed Plan.	Dunlap, Westshore Engineering	Cozza, USEPA	Correspondence
	3	88/09/12	Concerns and comments by the State of Michigan and a request that they be included in the final ROD	Gary Guenther-MDNR	Mary Gade - USEPA	Correspondence

ADMINISTRATIVE RECORD INDEX UPDATE NO. 2
MASON COUNTY LANDFILL
MASON COUNTY, MICHIGAN

FICHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE
			along with conditional acceptance of the Draft ROD as recieved on 8/17/88.			
	2	88/09/13	Conditional acceptence of the Proposed Plan for Remediation.	Bill Herceg-MDNR	Dan Cozza - USEPA	Correspondence
	3	88/09/20	Letter addressing concerns in the ROD and indicates how those concerns have been or will be addressed.	Mary Gade - USEPA	Gary Guentner-USEPA	Correspondence
	4	88/08/00	Fact Sheet : Mason County Landfill Feasibility Study Completed with information re: time and place of 8-17-88 public meeting	USEPA		Fact Sheet
	69	88/08/17	Transcript of 8-17-88 public meeting	McLouth, Certified Electronic Oper.		Meeting Notes
	27	88/04/08	Letter responding to request for State Applicable or Relevant and Appropriate Requirements (ARARs) pertinent to the Mason County site, including ARARs mentioned	Herceg, MDNR	Cozza, USEPA	Other
	26	87/12/00	Draft Technology Screening And Alternatives Development Technical Memorandum			Reports/Studies
	456	88/07/12	Final RI Report	CH2M Hill	USEPA	Reports/Studies
	14	88/08/04	USEPA's Proposed Plan for Mason Cty. site	USEPA		Reports/Studies
	151	88/06/05	Public Comment Report on the Feasibility Study Report	CH2M Hill	USEPA	Reports/Studies

SUMMARY OF INTERIM REMEDIAL ALTERNATIVE SELECTION

MASON COUNTY LANDFILL
MASON COUNTY, MICHIGAN

September, 1988

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1. Letter from MDNR to U.S. EPA dated September 13, 1988
2. Letter from U.S. EPA to MDNR dated September 20, 1988
3. Responsiveness Summary

SUMMARY OF INTERIM REMEDIAL ALTERNATIVE SELECTION

MASON COUNTY LANDFILL
MASON COUNTY, MICHIGAN

I. SITE LOCATION AND DESCRIPTION

The Mason County Landfill Site is located three miles south of the City of Ludington and one mile east of Lake Michigan (see Figures 1 and 2). The Site occupies approximately eighteen acres of a predominantly rural area in Pere Marquette Township; approximately ten acres of the Site is landfilled.

Ludington, Michigan has a population of about 9,500. The population of Mason County was estimated at 26,400 based on the 1980 census. The population within a three mile radius of the Site was estimated at 1,112.

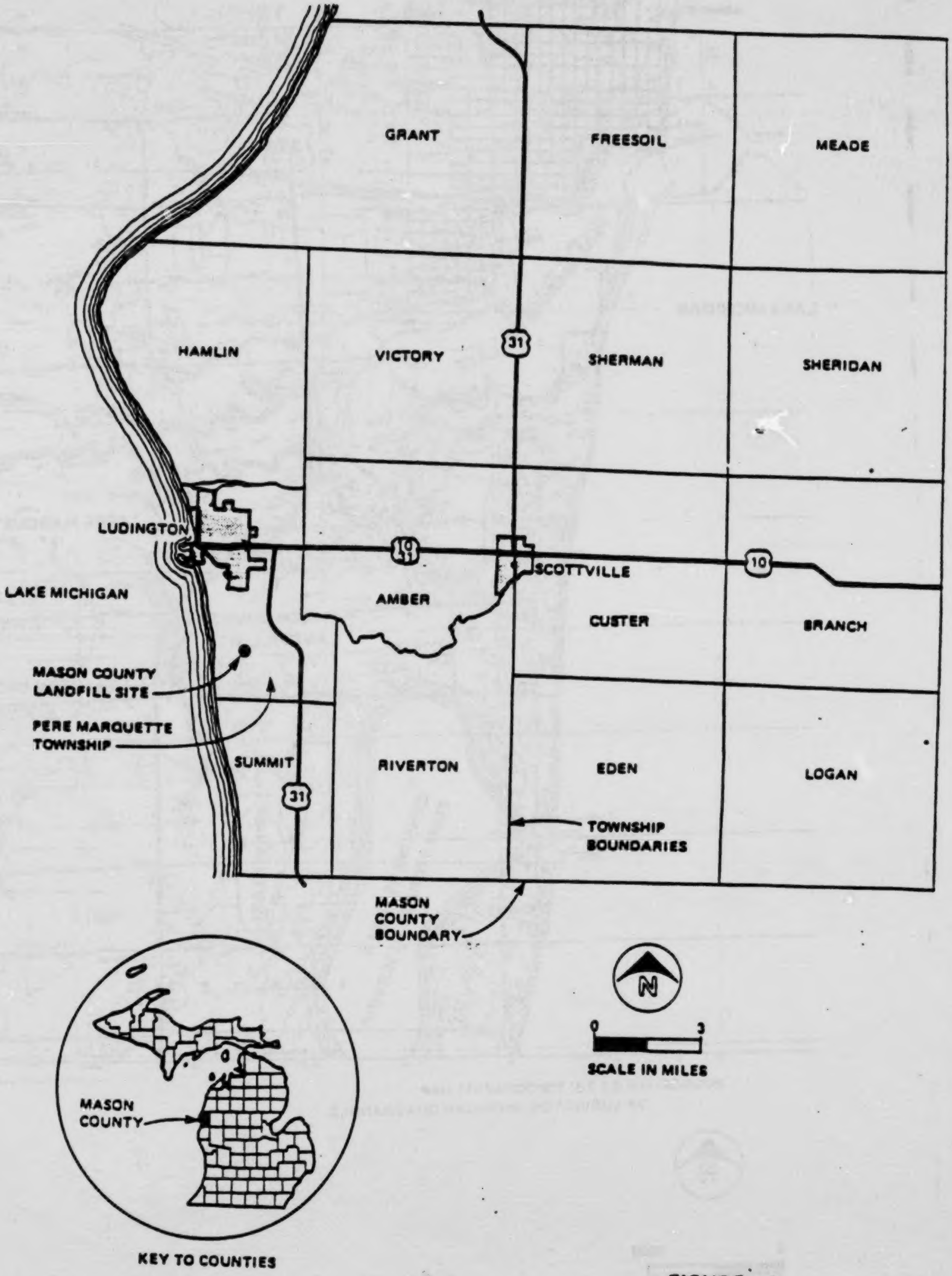
As Figure 3 indicates, just north of the Site is heavily wooded and orchards are located to the east and south of the Site. The local topography varies from relatively level upland areas south and east of the landfill to steep valleys north of the landfill. Figure 3 shows both the current topography and Site topography before landfilling began in 1971. Comparison of the topographic contours indicates that an estimated 140,000 cubic yards (+/- 20,000 cubic yards) of fill is buried in the landfill. The landfill is generally a valley fill with a maximum depth estimated to be 40 to 50 feet.

Surface waters in the Site area are Iris Creek, the Pere Marquette River, Pere Marquette Lake, and Lake Michigan (see Figure 2). The headwaters of Iris Creek are located less than 500 feet from the landfill and consist of a wet, marshy area southwest of Babbin Road (see Figure 3). Water from the marshy area drains into Babbin Pond, which discharges directly into Iris Creek. Iris Creek discharges into Pere Marquette River, which discharges into Lake Michigan. A pumped-storage power reservoir operated by Consumers Power Company is located approximately one half mile south of the Site.

Lake Michigan is the main drinking water source in the area and is the City of Ludington's water supply. In rural Pere Marquette Township, residents generally depend on small domestic wells screened in sand and gravel aquifers for potable water supplies. There are fourteen residential wells within about a half mile radius of the landfill that vary in depth from 30 to 150 feet below ground surface (bgs). They are monitored biannually by the Mason County Department of Public Health for a range of organic parameters.

Other water uses in the area include large capacity wells that produce salt brine for industrial use. A salt brine well about 1,000 feet west of the landfill is screened in an aquifer at a depth of 450 feet bgs. The brine aquifer is separated from the overlying aquifers used for potable water by more than 300 feet of low permeability glacial till.

Mason County is underlain by bedrock formations at depths from 300 to 700 feet. Mississippi Age Coldwater Shale lies beneath the landfill Site at a depth of 650 feet. The formation is predominantly shale with occasional interbeds of sandstone and limestone.


GRANT
FREESOIL
MEADE
HAMLIN
VICTORY
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SHERMAN
SHERIDAN
LUDINGTON
10
31
SCOTTVILLE
10
LAKE MICHIGAN
AMBER
CUSTER
BRANCH
MASON COUNTY
LANDFILL SITE
PERE MARQUETTE
TOWNSHIP
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31
RIVERTON
EDEN
LOGAN
TOWNSHIP
BOUNDARIES
MASON
COUNTY
BOUNDARY
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0
3
SCALE IN MILES
MASON
COUNTY
KEY TO COUNTIES

FIGURE 1
LOCATION MAP
MASON COUNTY LANDFILL RI/FS

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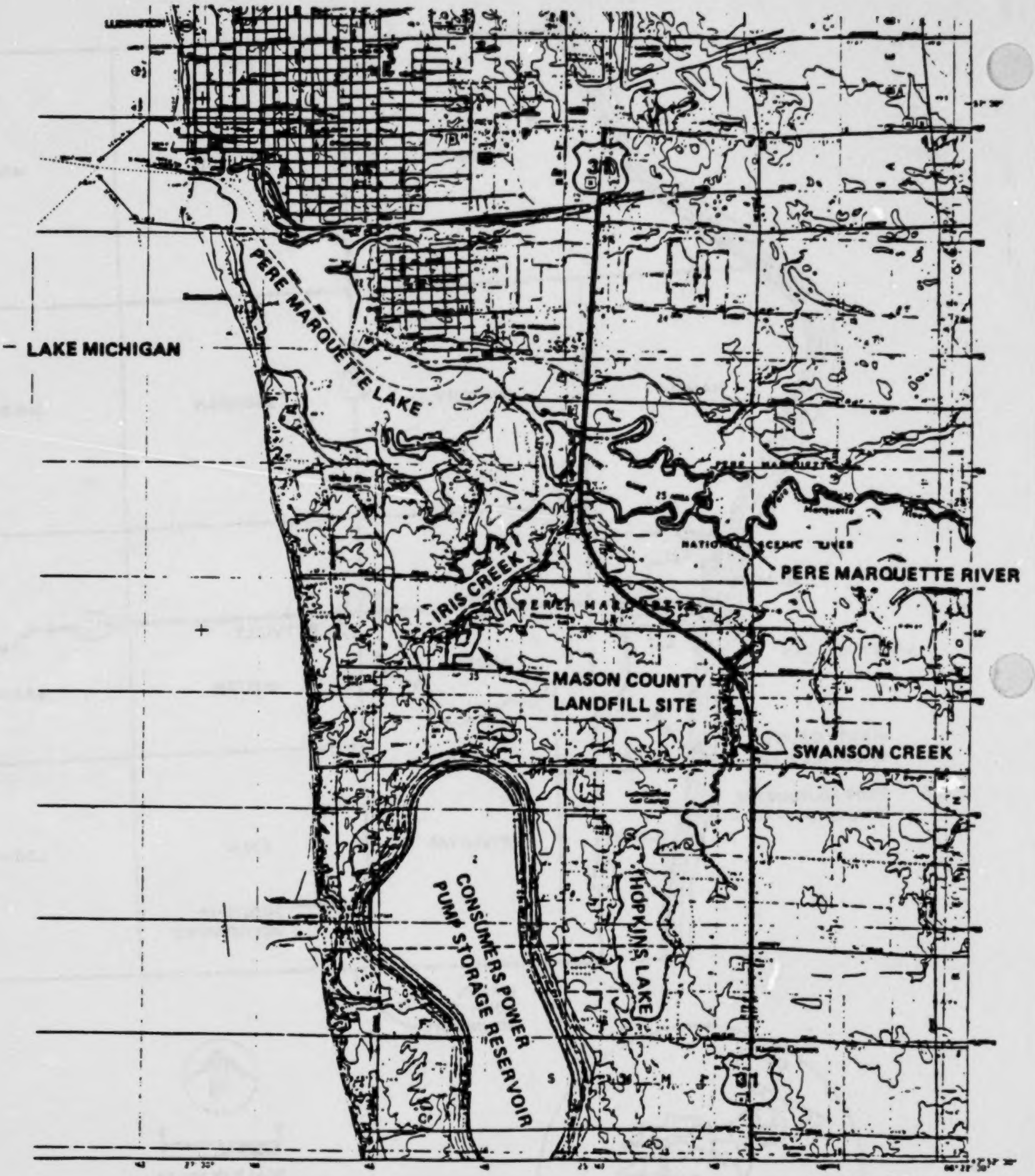

LUDINGTON
LAKE MICHIGAN
PERE MARQUETTE LAKE
31
NATIONAL SCENIC RIVER
PERE MARQUETTE RIVER
IRIS CREEK
MASON COUNTY
LANDFILL SITE
SWANSON CREEK
CONSUMERS POWER
PUMP STORAGE RESERVOIR
HOPKINS LAKE
31

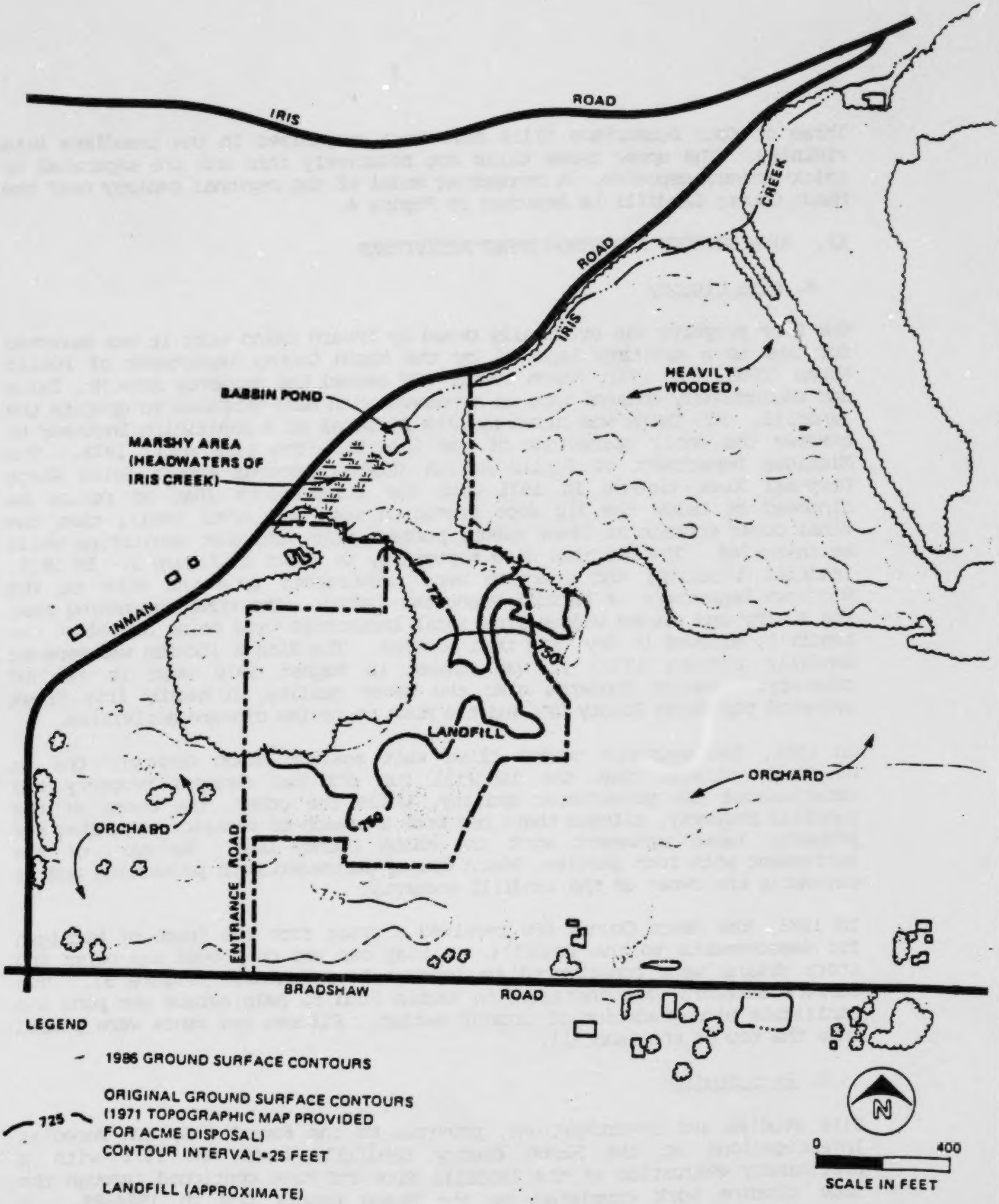
SOURCE: U.S.G.S 7.5' TOPOGRAPHIC MAP
OF LUDINGTON, MICHIGAN QUADRANGLE.

N

0 4000

SCALE IN FEET

FIGURE 2
VICINITY MAP
MASON COUNTY LANDFILL RI/F


IRIS
ROAD
CREEK
ROAD
IRIS
HEAVILY WOODED
BABBIN POND
MARSHY AREA (HEADWATERS OF IRIS CREEK)
775
725
750
INMAN
LANDFILL
ORCHARD
ORCHARD
750
ENTRANCE ROAD
775
BRADSHAW
ROAD
N
0
400
SCALE IN FEET

LEGEND

- 1986 GROUND SURFACE CONTOURS

725 ORIGINAL GROUND SURFACE CONTOURS (1971 TOPOGRAPHIC MAP PROVIDED FOR ACME DISPOSAL)
CONTOUR INTERVAL=25 FEET

LANDFILL (APPROXIMATE)

PROPERTY LINE (APPROXIMATE)

NOTE: Approximate landfill and property boundaries based on Mason County DPW legal property description and aerial photograph.

FIGURE 3
SITE MAP WITH ORIGINAL SITE TOPOGRAPHY
MASON COUNTY LANDFILL FS

Three or four subsurface tills have been recognized in the immediate Site vicinity. The upper three tills are relatively thin and are separated by thick outwash deposits. A conceptual model of the regional geology near the Mason County Landfill is depicted in Figure 4.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

A. Site History

The Site property was originally owned by Edward Dains when it was selected for use as a sanitary landfill by the Mason County Department of Public Works (DPW). In 1971, Mason County DPW leased the property from Mr. Dains and subsequently entered into an agreement with Acme Disposal to operate the landfill. Mr. Dains was hired by Acme Disposal as a Sanitation Engineer to oversee the daily operations of the landfill from 1972 until 1978. The Michigan Department of Public Health (MDPH) approved Acme's Solid Waste Disposal Area license in 1971 with the stipulations that no refuse be disposed of below the 710 foot elevation mean sea level (msl), that the final cover contain at least twenty percent clay, and that monitoring wells be installed. The original Site topography is shown in Figure 3. In 1973, landfill licensing and oversite were transferred from the MDPH to the Michigan Department of Natural Resources (MDNR). The MDNR documented that the slurry and sludge wastes from local industries were being dumped at the landfill, allowed to dry, and then covered. The Site's license was renewed annually through 1977; it was closed in August 1978 when it reached capacity. Public concerns over the water quality in nearby Iris Creek prompted the Mason County DPW and the MDNR to review closure activities.

In 1981, two property owners filed suit against Mason County. One, a neighbor, alleged that the landfill run off had damaged property and deteriorated the groundwater quality, while the other, the owner of the landfill property, alleged there had been a breach of contract regarding the property lease agreement with the Mason County DPW. As part of the settlement with both parties, Mason County purchased both properties and is currently the owner of the landfill property.

In 1983, the Mason County DPW received a grant from the State of Michigan for improvements to the landfill. A clay cap was completed and berms and storm drains were constructed to improve Site drainage (Figure 5). Two surface aerators were installed in Babbin Pond to help aerate the pond and facilitate biodegradation of organic matter. Fifteen gas vents were placed into the top of the landfill.

B. Past Studies

Site studies and investigations, previous to the formal U.S. EPA Remedial Investigations at the Mason County Landfill, began in 1971 with a preliminary evaluation of the landfill Site and have continued through the Site closure work completed by the Mason County DPW in 1984-85. A chronological summary of the major landfill investigations is provided in Table 1.

TABLE 1 (Page 1 of 2)
Summary of Previous Site Investigations

Investigation or Study	Years	Objectives	Conclusions	Limitations
Initial Site Studies by Michigan Department of Public Health (MDPH)	1971	Characterize site soil conditions for potential landfill site	Site could be used as an interim landfill facility with limitations	Very limited field data collected Soil borings completed using augers without stratigraphic sampling No monitoring wells installed
Mason County DPW Residential Well Sampling and Analysis	1971-Present	Monitor residential drinking water quality with time near the landfill	Documented degradation of S. Dains' well water with increasing nitrate and tetrachloroethene concentrations with time	Not a complete U.S. EPA priority pollutant analysis
Consumers Power Geotechnical Investigation for the Pumped Storage Reservoir	1976	Monitor groundwater levels in five observation wells installed around pumped storage reservoir	Unknown	Unknown
Mason County DPW Monitoring Well Installations	1976-77	Monitor groundwater levels and water quality in four wells installed around landfill	Established groundwater flow generally to the north in the landfill area	Well grouting and seal details unknown
Michigan DNR Refuse Boring	1977	Establish thickness of landfill and whether landfill contents are below the water table	Established the thickness of landfill contents is 40 ft with a minimum 30 ft of unsaturated soil below the bottom of the fill at the boring location	Drilling methods used did not provide stratigraphic samples Only provides information at one point in the landfill
Michigan DNR Iris Creek Surface Water--Sediment Investigation	1977	Analyze surface water and sediment samples from Iris Creek	Suggested that degradation of Iris Creek was caused by leaf litter, slash material from logging, and septic seepage and not from landfill leachate	No priority pollutants analyzed Did not compare surface water and groundwater constituents
Mason County DPW Review of Michigan DNR's Iris Creek Surface Water--Sediment Investigation	1977	Critical review of the Michigan DNR study and conclusions	Disagreed with MDNR's conclusions and suggested that landfill leachate entering Iris Creek could not be discounted; recommended installing additional monitoring wells between the landfill and Iris Creek	Did not attempt to characterize leachate from the landfill No new field data collected to support conclusions

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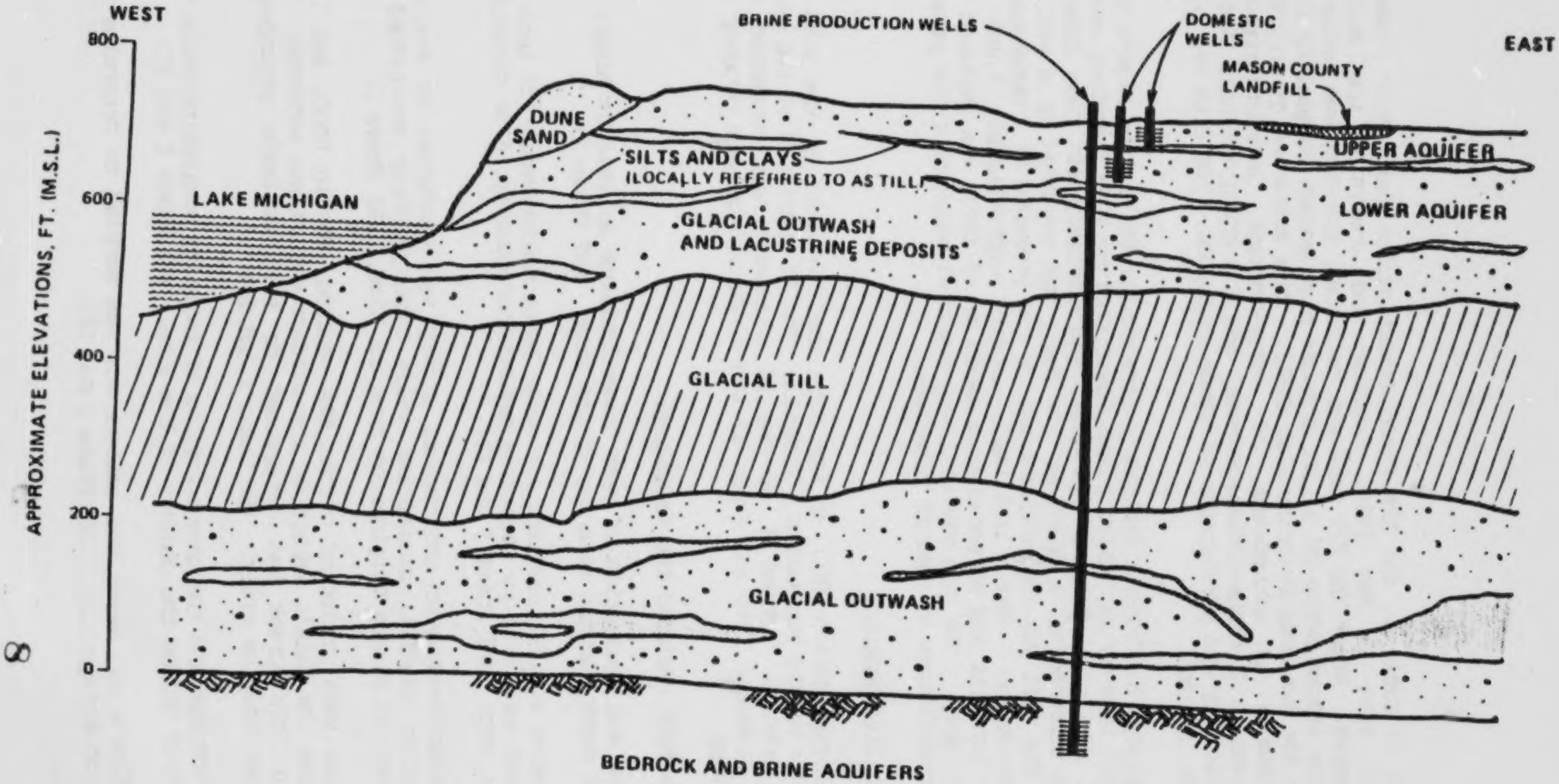
TABLE 1 (Page 2 of 2)
Summary of Previous Site Investigations

Investigation or Study	Years	Objectives	Conclusions	Limitations
Mason County DPW Monitoring Well Installations	1978	Supplement four existing wells new wells; sample and analyze	Unknown	Well grouting and seal details unknown, and drilling methods used did not provide stratigraphic samples
Acme Monitoring Well Installations	1978	Supplement existing wells with four additional monitoring wells; sample and analyze	Unknown	Well grouting and seal details unknown, and drilling methods used did not provide stratigraphic samples Well log unavailable for well MW-6
Michigan DNR Geophysical Survey and Test Borings	1979-80	Conducted electrical resistivity survey around the landfill and completed borings to define site stratigraphy and identify areas of groundwater contamination	Identified low resistivity area north of the landfill and detected high chloride concentrations in groundwater in two borings with temporary casings between the landfill and Iris Creek	Only sampled groundwater in two borings Boring locations and elevations not surveyed Resistivity survey covered a very small area
Mason County DPW Landfill Assessment	1981	Review and organize site data from earlier investigations and recommend methods to close the site	Recommended a hydrogeologic study and methods to cover the site, control erosion, stabilize steep slopes, promote drainage, and vent landfill gas	No new data collected other than water level measurements in existing monitoring wells Interpreted groundwater flow in the site area without attempting to identify distinct and separate aquifers
U.S. EPA Field Investigation Team (FIT) Site Assessment	1982	Develop score to evaluate site for the U.S. EPA's National Priorities List (NPL) of sites under CERCLA (Superfund)	The hazard ranking system (HRS) score calculated for the site qualified it for further consideration under CERCLA because of documented organic compounds in surface water and groundwater near the site	Very limited number of groundwater, surface water, and sediment samples collected and analyzed for U.S. EPA Priority Pollutants Questionable validity of some inorganic and organic results due to blank contamination
Mason County Site Studies conducted during Remedial Activities	1983-85	Evaluate effectiveness of capping and site drainage by installing wells and analyzing surface water, sediment, and groundwater before, during and after the construction period	Suggested that the closure measures decreased the volume of leachate generated by the landfill	Samples not analyzed for complete list of U.S. EPA Priority Pollutants


WEST
EAST
APPROXIMATE ELEVATIONS, FT. (M.S.L.)
800
600
400
200
0
BRINE PRODUCTION WELLS
DOMESTIC WELLS
MASON COUNTY LANDFILL
UPPER AQUIFER
LOWER AQUIFER
DUNE SAND
SILTS AND CLAYS (LOCALLY REFERRED TO AS TILL)
LAKE MICHIGAN
GLACIAL OUTWASH AND LACUSTRINE DEPOSITS
GLACIAL TILL
GLACIAL OUTWASH
BEDROCK AND BRINE AQUIFERS

–NOT TO SCALE–

FIGURE 4
CONCEPTUAL GEOLOGY
AT MASON COUNTY LANDFILL

As indicated in Table 1, the EPA Field Investigation Team (FIT) inspected the landfill Site in May 1982, sampling and analyzing the existing monitoring wells. After the FIT data was evaluated, the Site was assigned a hazard ranking system score of 34.18, a score high enough to qualify it for inclusion on the National Priority List (NPL). This score was given because of the presence in groundwater of ethyl-benzene, pentachlorophenol, trichloroethene, 1,2 trans-dichloroethene, and 1,1-dichloroethene and the associated toxicity and persistence of these compounds. The Site was put on the final NPL in 1982.

The MDPH replaced S. Dains's and May's residential wells (see Figure 5) in September 1987 because of health risks identified by MDPH sampling done in the fall of 1986. S. Dains's old well, approximately 400 feet from the landfill and screened at a depth of 130 feet, was replaced by a well 348 feet deep. The well was replaced because of the presence of 2-butanone and 4-methyl-2-pentanone. May's old well, located approximately 1,200 feet north of the landfill and screened at a depth of 60 feet, was replaced by a well 218 feet deep. The old May well was replaced because of the presence of trace concentrations of tetrachloroethene.

C. Current Site Status

A Remedial Investigation (RI) at the Site was conducted by the U.S. EPA through the use of its contractor, CH2MHill. The RI consisted of two phases or sampling events. Phase I of the RI fieldwork was conducted from September to November 1986 and Phase II was conducted between October 1987 and January 1988.

The RI at the Site included the following:

1. Review and evaluation of past investigations as well as historical practices and other records relating to the Site. (RI Phase I)

2. Extensive aquifer sampling and water level measurements (in both the upper and lower aquifers) to determine groundwater quality, flow directions and gradients, etc. (RI Phase I and II)

3. An electromagnetic geophysical survey was conducted to evaluate whether existing landfill monitoring wells were properly positioned to interpret potential plumes originating from the Site. (RI Phase I)

4. Samples were collected within the wetland, Babbin Pond, and Iris Creek to define the Site's impact on the surface waters and sediment. The base flow in Iris Creek was determined to help estimate groundwater discharge rates into the creek. (RI Phase I and II)

5. Soil borings and the gamma logging of existing monitoring wells was conducted to help define the geology of the Site. (RI Phase I and II)

6. The Site's gas vents and ambient air was sampled to determine the Site's impact on air quality. (RI Phase I and II)

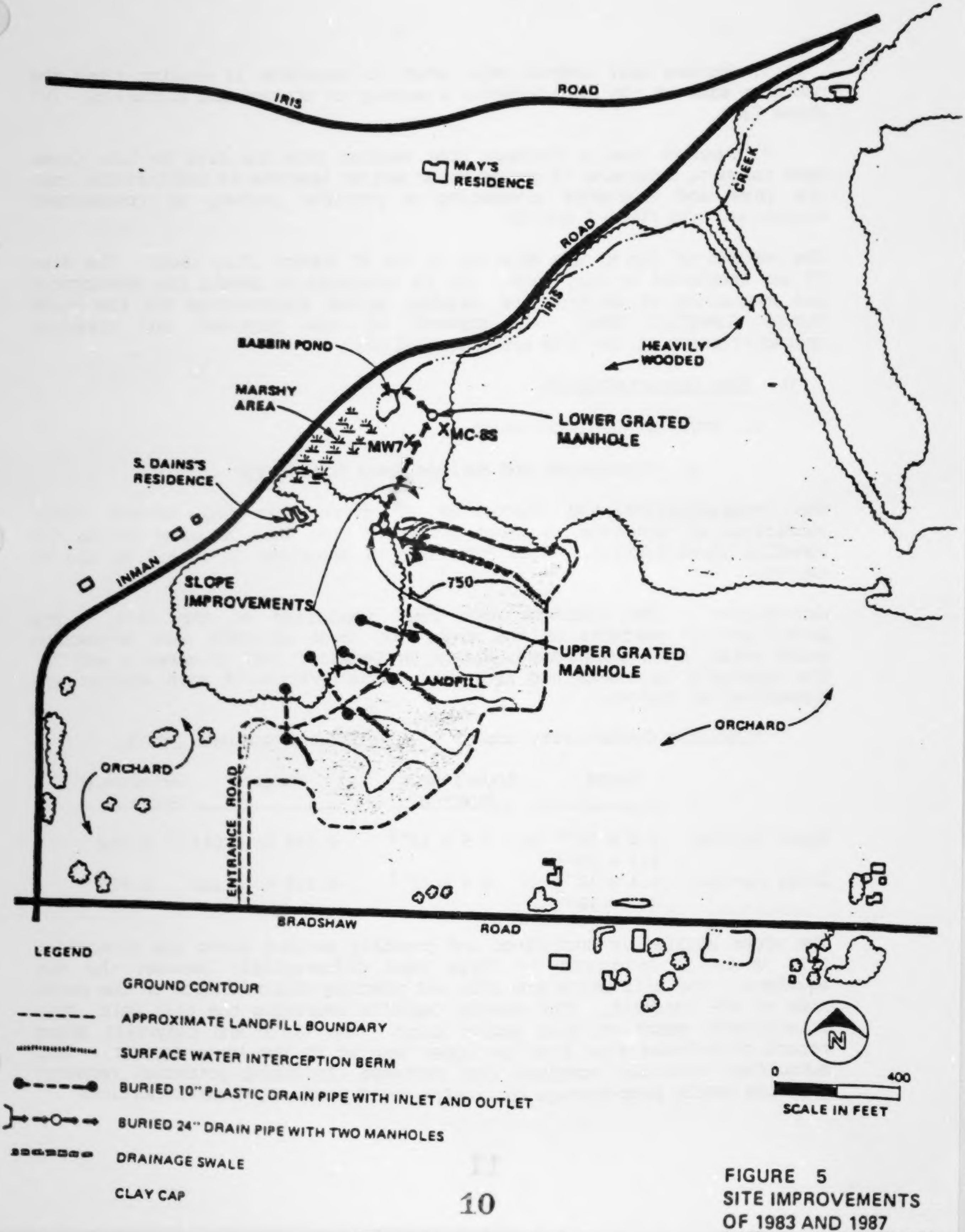

IRIS
ROAD
MAY'S RESIDENCE
CREEK
ROAD
IRIS
BABBIN POND
HEAVILY WOODED
MARSHY AREA
LOWER GRATED MANHOLE
MW7
MC-8S
S. DAINS'S RESIDENCE
INMAN
SLOPE IMPROVEMENTS
750
UPPER GRATED MANHOLE
LANDFILL
ORCHARD
ORCHARD
ENTRANCE ROAD
BRADSHAW
ROAD
LEGEND
GROUND CONTOUR
APPROXIMATE LANDFILL BOUNDARY
SURFACE WATER INTERCEPTION BERM
BURIED 10" PLASTIC DRAIN PIPE WITH INLET AND OUTLET
BURIED 24" DRAIN PIPE WITH TWO MANHOLES
DRAINAGE SWALE
CLAY CAP
N
0
400
SCALE IN FEET

FIGURE 5
SITE IMPROVEMENTS
OF 1983 AND 1987
MASON COUNTY LANDFILL FS

7. Surface soil samples were taken to determine if erosion along the northern side of the Site presents a pathway of contaminant migration. (RI Phase II)

8. Samples from a drainage pipe leading from the Site to Iris Creek were taken to determine if ground water and/or leachate is infiltrating into the pipe and therefore presenting a possible pathway of contaminant migration. (RI Phase I and II)

The results of the RI are detailed in the RI Report (July 1988). The Site FS was completed in July 1988. The FS documents in detail the development and evaluation of an array of remedial action alternatives for the Mason County Landfill Site. A summary of the physical and chemical characteristics of the Site are discussed below.

D. Site Characteristics

1. Physical Characteristics

a. Groundwater and Surface Water Conditions

The interpretation and discussion of groundwater and surface water conditions at the Site is based primarily upon data obtained during the remedial investigation. Site hydrology is described in detail in the RI report.

Groundwater - Two aquifers have been identified at the Site. The potentiometric surfaces of the upper and lower aquifers were determined using water level measurements taken in December 1987 (Figures 6 and 7). The hydraulic gradients and hydraulic conductivities of each aquifer are summarized as follows:

	Hydraulic Conductivity (cm/s)		Hydraulic Gradient (ft/ft)	
	Range	Logarithmic Average	Range	Arithmetic Average
Upper Aquifer	5.0×10^{-4} to 8.7×10^{-3}	2.5×10^{-3}	0.040 to 0.064	0.052
Lower Aquifer	6.1×10^{-3} to 2.4×10^{-2}	4.4×10^{-3}	0.018 to 0.310	0.025

The upper aquifer is unconfined and possibly perched above the subsurface till units as evidenced by large head differentials between the two aquifers. The till units are thin and possibly discontinuous on the north side of the landfill. The outwash deposits overlying the till units have interlayered seams of silt and/or clay. The tills and clay/silt seams retard groundwater flow from the upper aquifer to the lower aquifer. This subsurface condition combined with recharge (including potential recharge from the nearby pump-storage reservoir) could produce perched conditions.

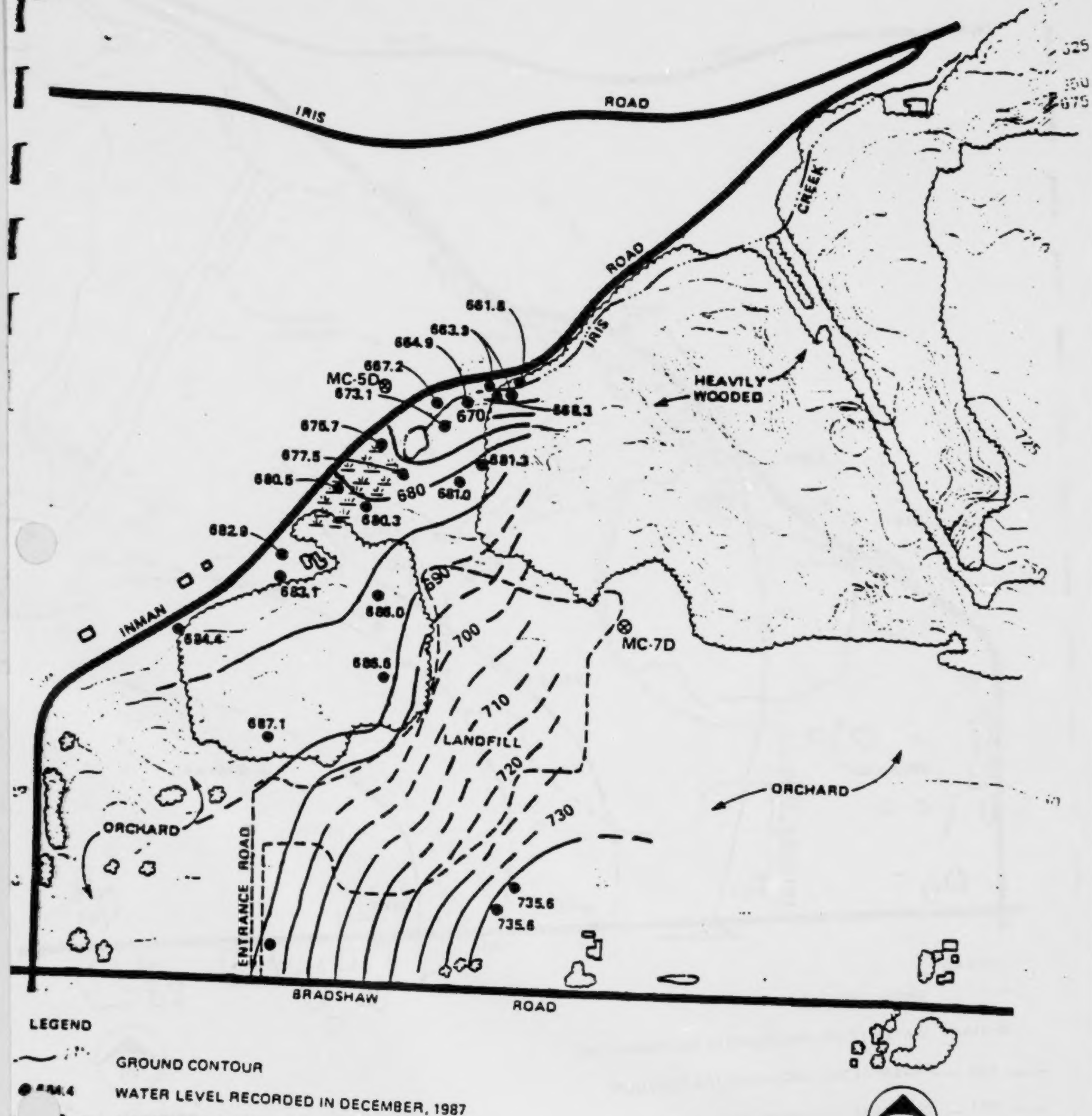

IRIS ROAD
INMAN ROAD
IRIS
ROAD
CREEK
HEAVILY WOODED
661.8
663.3
664.9
667.2
MC-5D
673.1
670
668.3
676.7
677.5
680.5
680
681.0
681.3
680.3
682.9
683.1
686.0
684.4
686.6
687.1
690
700
710
720
730
MC-7D
LANDFILL
ORCHARD
ORCHARD
ENTRANCE ROAD
735.6
735.6
BRADSHAW ROAD
625
650
675
725
LEGEND
GROUND CONTOUR
WATER LEVEL RECORDED IN DECEMBER, 1987
INTERPRETED GROUNDWATER CONTOUR
INFERRED GROUNDWATER CONTOUR
BORINGS WHERE SHALLOW AQUIFER WAS NOT ENCOUNTERED IN NOVEMBER 1987
N
0
400
SCALE IN FEET

FIGURE 6
UPPER AQUIFER
POTENTIOMETRIC SURFACE

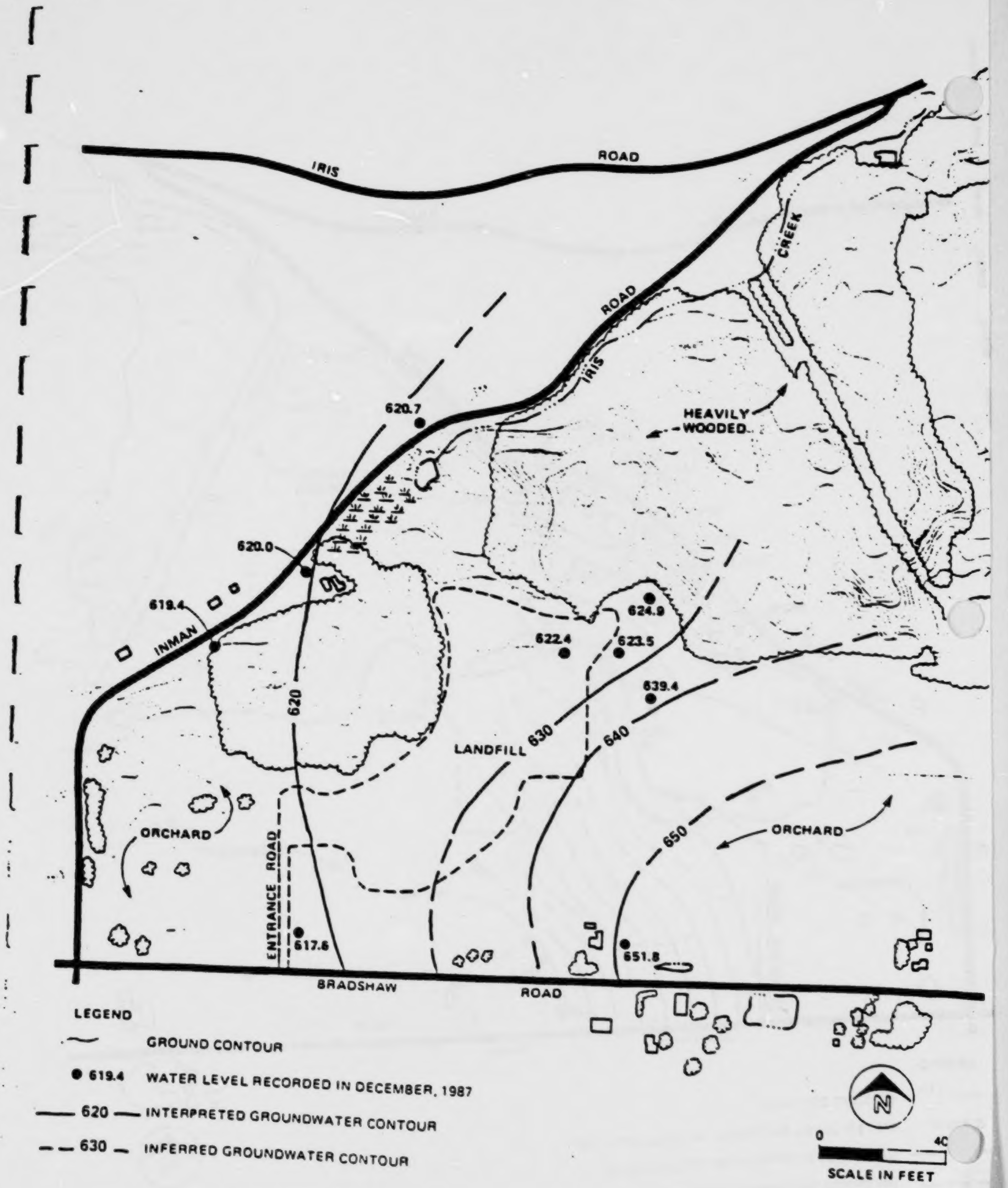

IRIS ROAD
IRIS ROAD
CREEK
HEAVILY WOODED
620.7
620.0
619.4
INMAN
624.9
622.4
623.5
639.4
620
630
640
650
LANDFILL
ORCHARD
ORCHARD
ENTRANCE ROAD
617.6
651.8
BRADSHAW ROAD
LEGEND
GROUND CONTOUR
619.4 WATER LEVEL RECORDED IN DECEMBER, 1987
620 INTERPRETED GROUNDWATER CONTOUR
630 INFERRED GROUNDWATER CONTOUR
N
0
4C
SCALE IN FEET

FIGURE 7
LOWER AQUIFER
POTENTIOMETRIC SURFACE
MASON COUNTY LANDFILL RI/FS

Water from the upper aquifer percolates downward to recharge the lower aquifer. Downward percolation is controlled by the thickness and permeability of the intervening till units and clay/silt seams. There may be areas where the intervening layers are missing, which would allow a larger quantity of water to percolate downward to the lower aquifer. Groundwater in the upper aquifer flows generally to the northwest and discharges into the wetlands, Babbin Pond and Iris Creek (see Figure 6).

In the lower aquifer both confined and unconfined conditions exist. The potentiometric surface in the lower aquifer is higher than the till unit along Inman Road, indicating a confined condition. East and south of the landfill, a 20 to 40-foot thick unsaturated zone of sand lies between the water surface in the lower aquifer and the till unit, indicating an unconfined condition.

Groundwater flow in the lower aquifer trends toward the northwest (see Figure 7) and eventually discharges to the Pere Marquette Lake and River and Lake Michigan. According to well logs from local brine wells owned and operated by Dow Chemical, the aquifer is underlain by a massive till unit (see Figure 4). The exact thickness of the lower aquifer at the Mason County Landfill Site is unknown.

Surface Water - The Site lies within the Pere Marquette River watershed. Surface water units near the Site include a wetland area at the base of the landfill that discharges to man-made Babbin Pond, which in turn discharges to Iris Creek. Since no upslope stream feeds the wetland area, the wetland area forms the headwaters of Iris Creek.

Iris Creek flows for about one mile through a series of small ponds and eventually discharges to the Pere Marquette River just west of Highway 31 (see Figure 2).

A 24-inch storm drain carrying surface runoff from the landfill cap discharges directly into Iris Creek. Other surface runoff from the landfill is channeled to the north through gullies that lie on the side slopes of the landfill (see Figure 5).

The wetland area is a local discharge area for groundwater that covers approximately 0.8 acre. Babbin Pond covers approximately 0.1 acre and contains about 200,000 gallons of water. The storm drain flow is probably intercepted groundwater because 1) the drain discharged water during several Site visits but no surface water was observed to be entering through grated inlets, 2) the drain pipe is buried below the water table based on a comparison of the manhole invert elevation to groundwater elevations in nearby wells MW7 and MC8S (See Figure 5) and, 3) the chemical characteristics of water in the drain are similar to those in nearby monitoring wells.

b. Groundwater/Surface Water Interaction

The surface waters are located topographically and hydraulically downgradient of the landfill. Surface runoff from the landfill area and groundwater from the upper aquifer discharge to the wetland area. Based on the discharge from Babbin Pond, surface water in the wetland area appears to be gaining about 46 gpm from groundwater. The combined water from Babbin Pond and the 24-inch storm drain feeds Iris Creek at a rate of about 48 gpm. The flow volume of 16 gpm in Iris Creek indicates that surface water is apparently lost to groundwater at a rate of about 32 gpm. The surface water measurements indicate that Iris Creek may be a flow-through creek (i.e., both gaining and losing water).

2. Chemical Characteristics

The following discussion briefly summarizes the nature and extent of contamination according to the respective media sampled during the two phases of the RI. Table 2 indicates the contaminants found throughout all media at the Mason County Landfill.

a. Groundwater

The upper aquifer - Thirteen monitoring wells and four residential wells are screened in the upper aquifer. Fourteen volatile organic compounds (VOCs) and ten semi-volatile organic compounds (SVOCs) were detected in the five downgradient monitoring wells within 400 feet of the landfill.

In general, the target compound list (TCL) or priority pollutant compounds that can be attributed to the landfill were predominantly VOCs. Six chlorinated volatile hydrocarbons were detected in at least one phase of the remedial investigation at concentrations ranging from 1 to 59 ppb. The highest concentration (59 ppb of 1,1-dichloroethene) was detected at MW1A during Phase I (refer to Figure 8 for all residential and monitoring well locations). 1,1-dichloroethene was not detected in Phase II, and only chloroethane, 1,1-dichloroethane, and tetrachloroethene were detected in both Phase I and Phase II. Benzene, ethylbenzene, xylene, 2-butanone, and 4-methyl-2-pentanone were found in both phases in concentrations ranging from 2 to 300 ppb. Toluene and 2-hexanone were detected only during Phase I at MW1A with concentrations of 75 and 19 ppb, respectively.

Table 3 is a comparison of the range of inorganic concentrations in the upgradient wells to their corresponding range and frequency of detection in wells downgradient of the landfill. The concentrations of iron, manganese, and sodium were at least one order-of-magnitude above upgradient levels in MW1A, MW3, and MW7 for both investigative phases. These wells are located within 400 feet of the landfill.

The residential wells do not appear to be contaminated from landfill activities with either organics or inorganics, based on a comparison to upgradient wells. Lead was detected in RW08 one order of magnitude greater than upgradient levels in Phase I. The well was sampled during Phase II both before and after purging to determine if the lead contamination was attributable to well construction or plumbing (piping or lead solder). Lead was not detected in either Phase II sample, so the lead detected during Phase I may be attributed to suspended lead particles or to laboratory contaminants.

Table 2 (Page 1 of 2)
CHEMICALS DETECTED AT THE MASON COUNTY LANDFILL

Chemical	Groundwater: Monitoring Wells	Groundwater: Residential Wells	Surface Water	Sediment	Gas	Surface Soil
VOLATILE ORGANIC COMPOUNDS						
Acetone	X				X	
Benzene	X	X[a]	X		X	X
2-Butanone	X				X	
Carbon Disulfide					X	
Carbon Tetrachloride					X	
Chlorobenzene					X	
Chloroethane	X		X		X	
Chloroform	X	X			X	X
Chloromethane					X	
2-Chloroethyl vinyl ether			X			
1,1-Dichloroethane	X	X[a]	X		X	X
1,2-Dichloroethane					X	
1,1-Dichloroethene	X				X	
1,2-Dichloroethene	X					
1,2-Dichloropropane					X	
Trans-1,2-Dichloroethene	X		X		X	X
Ethylbenzene	X	X[a]	X	X	X	X
2-Hexanone	X				X	X
4-Methyl-2-Pentanone	X	X[a]			X	
Methylene Chloride				X		
Styrene				X		
Tetrachloroethene	X	X			X	
1,1,2,2-Tetrachloroethane					X	
1,2,4-Trichlorobenzene						
Toluene	X	X[a]	X	X	X	X
1,1,1-Trichloroethene					X	
Trichloroethene	X	X			X	
Vinyl Chloride					X	
Xylenes	X		X	X	X	
BASE/NEUTRAL EXTRACTABLES						
Polycyclic Aromatic Hydrocarbons						
Acenaphthene						X
Acenaphthylene						X
Anthracene						X
Benzo(a)anthracene				X		X
Benzo(a)pyrene				X		X
Benzo(b)fluoranthene				X		X
Benzo(k)fluoranthene						X
Bis-(2-Chloroisopropyl)ether						X
2-Chloronaphthalene						X
4-Chlorophenyl-phenylether			X	X		X
Chrysene				X		X
Dibenzofuran						X
Fluoranthene				X		X
Fluorene						X
2-Methyl Naphthalene						X
Naphthalene	X			X		X
Phenanthrene				X		X
Pyrene				X		X
N-Nitrosodiphenylamine				X		X
1,2,4-Trichlorobenzene						X
1,2-Dichlorobenzene						X
1,3-Dichlorobenzene						X
1,4-Dichlorobenzene	X					

Table 2 (Page 1 of 2)
CHEMICALS DETECTED AT THE MASON COUNTY LANDFILL

Chemical	Groundwater		Surface Water	Sediment	Gas	Surface Soil
	Monitoring Wells	Residential Wells				
VOLATILE ORGANIC COMPOUNDS						
Acetone	X				X	
Benzene	X	X[a]	X		X	X
2-Butanone	X				X	
Carbon Disulfide					X	
Carbon Tetrachloride					X	
Chlorobenzene					X	
Chloroethane	X		X		X	
Chloroform	X	X			X	X
Chloromethane					X	
2-Chloroethyl vinyl ether			X			
1,1-Dichloroethane	X	X[a]	X		X	X
1,2-Dichloroethane					X	
1,1-Dichloroethene	X				X	
1,2-Dichloroethene	X					
1,2-Dichloropropane					X	
Trans-1,2-Dichloroethene	X		X		X	X
Ethylbenzene	X	X[a]	X	X	X	X
2-Hexanone	X				X	X
4-Methyl-2-Pentanone	X	X[a]			X	
Methylene Chloride				X		
Styrene				X		
Tetrachloroethene	X	X			X	
1,1,2,2-Tetrachloroethane					X	
1,2,4-Trichlorobenzene						
Toluene	X	X[a]	X	X	X	X
1,1,1-Trichloroethene					X	
Trichloroethene	X	X			X	
Vinyl Chloride					X	
Xylenes	X		X	X	X	
BASE/NEUTRAL EXTRACTABLES						
Polycyclic Aromatic Hydrocarbons						
Acenaphthene						X
Acenaphthylene						X
Anthracene				X		X
Benzo(a)anthracene				X		X
Benzo(a)pyrene				X		X
Benzo(b)fluoranthene						X
Benzo(k)fluoranthene						X
Bis-(2-Chloroisopropyl)ether						X
2-Chloronaphthalene						X
4-Chlorophenyl-phenylether			X	X		X
Chrysene				X		X
Dibenzofuran						X
Fluoranthene				X		X
Fluorene						X
2-Methyl Naphthalene						X
Naphthalene	X			X		X
Phenanthrene				X		X
Pyrene				X		X
N-Nitrosodiphenylamine				X		X
1,2,4-Trichlorobenzene						X
1,2-Dichlorobenzene						X
1,3-Dichlorobenzene						X
1,4-Dichlorobenzene	X					

Table 3
SUMMARY OF UPPER AQUIFER INORGANIC CONSTITUENTS

Constituent	CLP Detection Limit (ug/1)	Range of Observed Background Concentrations[a] (ug/1)	Range of Observed Downgradient Concentrations[c] (ug/1)	Frequency of Downgradient Detections[d]	
				Total Number of Detections	Number of Detections an Order of Magnitude Above Background
Aluminum	200	150-310	120-1,100	6	0
Arsenic	10	[5][b]	10-16	4	0
Barium	200	13-28	4-450	17	2
Boron	80	[40][b]	82-170	2	0
Cadmium	5	5.3	0.5-6.4	5	0
Calcium	5,000	45,000-115,000	24,000-220,000	25	0
Chromium	10	4-6	4-19	7	0
Copper	25	[12.5][b]	8-97	10	0
Iron	100	[50][b]	320-21,000	8	7
Lead	5	14-38	5-260	5	1
Lithium	10	[5]	12	1	0
Magnesium	5,000	19,000-47,000	8,500-250,000	25	0
Manganese	15	4-44	4-2,320	15	10
Mercury	0.2	[0.1][b]	0.2	1	0
Nickel	40	[20][b]	15-23	2	0
Potassium	5,000	915	690 - 62,000	17	3
Silver	10	[5][b]	27	1	0
Sodium	5,000	3,800-4,500	1,300-840,000	17	12
Thallium	10	[5][b]	1.8-2.2	2	0
Vanadium	50	3.4-4.4	3.4-9.8	5	0
Zinc	20	64-10,000	45-18,000	21	0

---

[a] Based on monitoring wells OWB, OWC and MC1S

[b] Element not detected in background; use 1/2 of detection limit for order-of-magnitude comparison.

[c] Based on monitoring wells OWA1, MW1A, MW3, MW4, and MW7; S. Dains's abandoned well; residential wells RW04, RW05,RW07, RW08, and RW10; and Phase II monitoring wells MC3S, MC4S, MC5S, and MC8S.

[d] Total possible number of detections is the total number of downgradient samples taken in both phases (equal to 25).

[e] Mean value of background samples used for order-of-magnitude comparison.

Table 4
SUMMARY OF LOWER AQUIFER INORGANIC CONSTITUENTS

Constituent	CLP Detection Limit (ug/l)	Range of Observed Background Concentrations[a] (ug/l)	Range of Observed Downgradient Concentrations[c] (ug/l)	Frequency of Downgradient Detections[d]	
				Total Number of Detections	Number of Detections an Order of Magnitude Above Background
Aluminum	200	110-160	---	0	0
Arsenic	10	[5][b]	18-2.9	2	0
Barium	200	11-1,200	10-54	6	0
Boron	80	[40][b]	54-160	3	0
Cadmium	5	0.6-0.8	0.3	1	0
Calcium	5,000	65,000-762,000	25,000-103,000	11	0
Chromium	10	3-76	---	0	0
Cobalt	6	[3][b]	7	1	0
Copper	25	6-28	7-21	7	0
Iron	100	500	500-3,900	3	0
Lead	5	3-28	2	1	0
Lithium	10	10	12-13	3	0
Magnesium	5,000	23,000-33,000	10,000-58,000	11	0
Manganese	15	1-22	19-390	7	2
Nickel	40	[20][b]	---	0	0
Potassium	5,000	13,000-180,000	560-9,300	6	0
Sodium	5,000	2,700-59,000	9,500-100,000	5	0
Strontium	10	79-84	110-120	3	0
Zinc	20	110-6,300	12-370	8	0

---

[a] Based on monitoring wells OWD, MW6, MC2D, and MC7D and residential wells RW01, RW02, and RW03.
[b] Element not detected in background; use 1/2 of detection limit for order-of-magnitude comparison.
[c] Based on monitoring wells MC3D, MC4D, and MC5D and residential wells RW06, RW09, RW10, RW11, and RW12.
[d] Total possible number of detections is the total number of downgradient samples taken in both phases (equal to 11).
[e] Mean value of background samples used for order-of-magnitude comparison.

GLT717/80-2

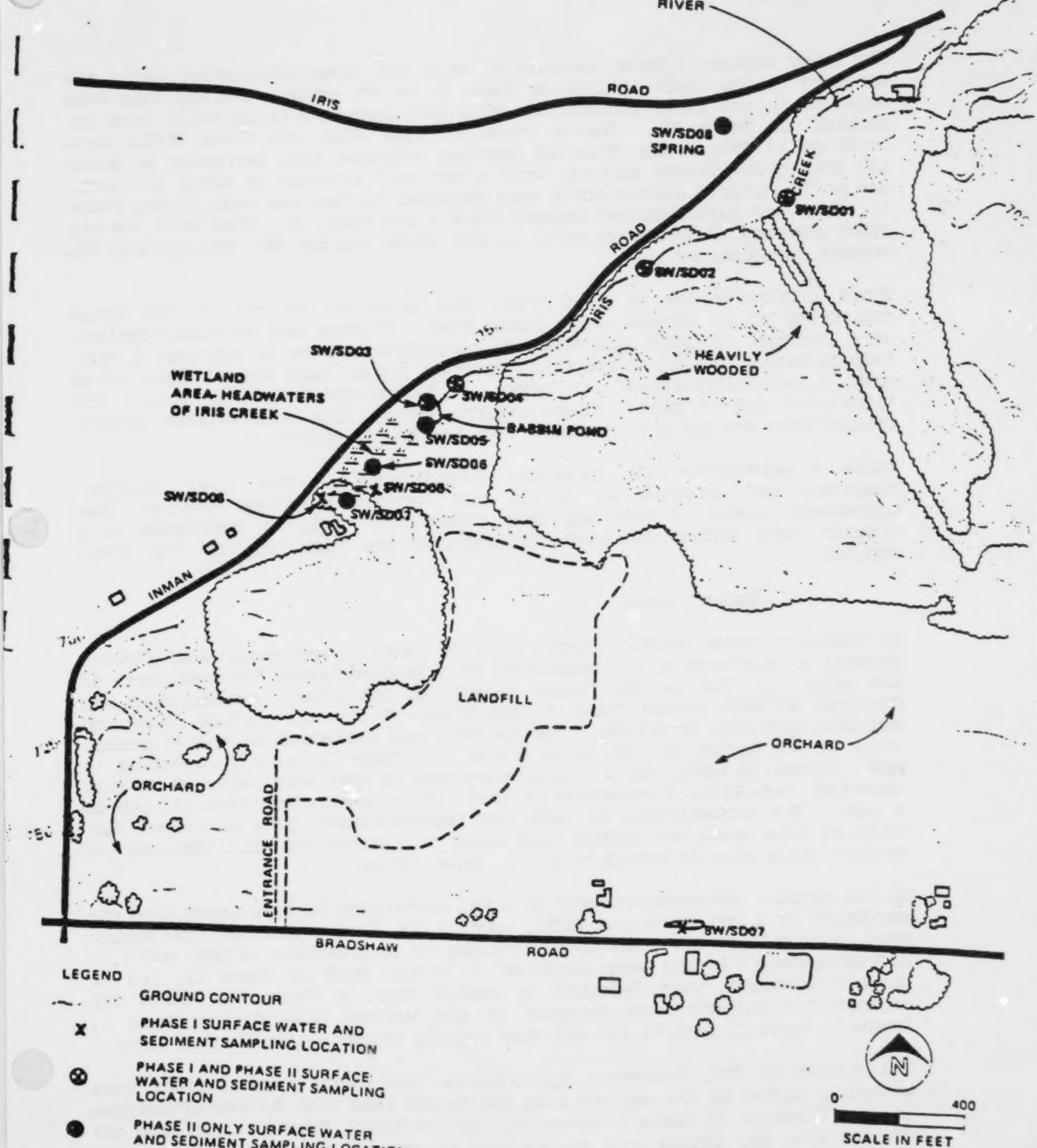

TO PERE-MARQUETTE RIVER
IRIS ROAD
SW/SD08 SPRING
CREEK
SW/SD01
IRIS ROAD
SW/SD02
HEAVILY WOODED
SW/SD03
WETLAND AREA- HEADWATERS OF IRIS CREEK
SW/SD04
BABBIN POND
SW/SD05
SW/SD06
SW/SD06
SW/SD08
SW/SD07
INMAN
LANDFILL
ORCHARD
ORCHARD
ENTRANCE ROAD
BRADSHAW ROAD
SW/SD07
N
0
400
SCALE IN FEET
LEGEND
GROUND CONTOUR
X PHASE I SURFACE WATER AND SEDIMENT SAMPLING LOCATION
⊗ PHASE I AND PHASE II SURFACE WATER AND SEDIMENT SAMPLING LOCATION
● PHASE II ONLY SURFACE WATER AND SEDIMENT SAMPLING LOCATION
STREAM
STRUCTURE
APPROXIMATE LANDFILL BOUNDARY

FIGURE 9
SURFACE WATER AND
SEDIMENT SAMPLING LOCATIONS
MASON COUNTY LANDFILL RI/FS

The lower aquifer - Seven monitoring wells and seven residential wells are screened in the lower aquifer in Phase I, no TCL organic contaminants were detected in the three residential wells and therefore these wells were not sampled in Phase II. During Phase I, five VOCs and three SVOCs were detected in RW06. The State of Michigan replaced RW06 (screened at about 130 feet below ground surface) with a new well screened at about 365 feet, and no TCL organic contaminants were detected in that new well during Phase II. RW10 was also replaced between Phase I and Phase II. That well and all other residential wells screened in the lower aquifer did not contain TCL organic contaminants.

Trace concentrations of five VOCs were detected in two of the three monitoring wells located along Inman Road. Benzene and tetrachloroethene were detected in MC3D and MC4D at concentrations of 2 ppb and 1 ppb, respectively. The other compounds detected in at least one of these wells are 1,1-dichloroethane (1 ppb), 1,2-dichloroethene (2 ppb), and trichloroethene (1 ppb). These results suggest that Site-related organic contaminants are being transported into the lower aquifer.

Table 4 summarizes the inorganic constituents in the lower aquifer. Manganese was detected at levels one order-of-magnitude greater than upgradient levels in MC4D and RW06 (Phase I). This is consistent with organic data indicating that contaminants are migrating to the lower aquifer.

b. Surface Water

As discussed above, surface runoff from the landfill and groundwater flowing beneath it discharge to the headwaters of Iris Creek about 500 feet north of the landfill. The largest number (eight) of TCL organic contaminants was detected at SW04 during Phase I (see Figure 9 for all surface water and sediment sampling locations. Sample SW04 was collected at the discharge point of the buried 24-inch storm drain. In Phase II, only chloroethene (2 ppb), xylene (4 ppb), and 1,1-dichloroethane (3 ppb) were detected at that location, indicating a reduction of total VOC concentration from 220 ppb to 9 ppb. The contaminants at SW04 are representative of groundwater just south of Iris Creek near Babbin Pond based on observations that indicate the 24-inch drain pipe is buried below the water table.

No TCL organic contaminants were detected downstream in Iris Creek with the exception of 2 ppb toluene at SW01, about 1,200 feet downstream from Babbin Pond, during Phase I. Trace concentrations of chloroethane (3 ppb) and 1,1-dichloroethane (3 ppb) were detected in Babbin Pond in Phase II, but no organic compounds were detected in Babbin Pond in Phase I. Three TCL organic contaminants were detected in the wetland area during Phase I; however, Phase II results did not show organic contamination in that area.

The number of TCL inorganic constituents and their concentrations were generally higher in the wetland area and Babbin Pond than further downstream in Iris Creek or in Phase I background sample SW07. Samples taken from the wetland area and Babbin Pond during both phases contained arsenic (3 to 13 ppb); nickel (19 ppb) and chromium (4 to 13 ppb) at this location in Phase I. Elevated concentrations of iron, manganese, and potassium found at SW04 during both phases support the hypothesis that the 24-inch storm drain is intercepting groundwater.

3. Sediment

Volatile organic compounds, semi-volatile organic compounds, and pesticides were detected in the sediments in the wetland area, Babbin Pond, and an upstream location (SD04) in Iris Creek. Toluene was found in sediment samples throughout that area. No TCL organics were detected at either downstream location in Iris Creek.

The only polycyclic aromatic hydrocarbons (PAHs) detected in any of the sediment samples were found in Phase I at SD07. The pesticide 4,4'-DDE was also detected at that location. Based on the topography of the Site area, SD07 is not affected by drainage from the landfill and these contaminants are probably from another source. The PAHs may be products of runoff from Bradshaw Road (asphalt surface) and the DDE is probably indicative of pesticides used in the orchards.

Concentrations of chromium, lead, and nickel were all relatively high in the wetland area compared to levels detected in downstream samples. However, the background sample SD07 had similar concentrations of these inorganics constituents. Arsenic was detected in four Phase II samples, but those data are questionable because of a problem encountered with laboratory procedures.

4. Surface Soil

Surface soil samples were taken only during Phase II. Few TCL volatile organic compounds were detected in surface soils. Toluene contamination appears to be most widespread, but that might not be attributable to the landfill, as evidenced by background levels. DDT was detected in the slopes north of the landfill. The presence of DDT and other pesticides at background locations indicates that pesticides were used for agriculture in the area. Sample SS17 (gully No. 3) was the only sample to contain PAHs as well as a wide variety of other semi-volatile organic compounds. Refer to Figure 10 for all surface soil locations.

According to the Site background results, inorganic contamination of on-site soils cannot be directly attributed to landfill activities. Arsenic, lead, and cyanide were detected sporadically throughout each group of samples. Sample SS13 in gully No. 3 contained 890 ppm of lead. However, the median value of lead in gully No. 3 was 2.7 ppm, and all other samples from this slope were one to two orders-of-magnitude less. The landfill cap has the most consistent levels of arsenic (4.2 to 8.9 ppm).. These samples were all taken from the clay cap, indicating that the imported clay may have naturally occurring levels of arsenic in this range. Cyanide was detected in very low concentrations in all three gullies, and the highest detection occurred in the orchard east of the landfill (5.8 ppm).

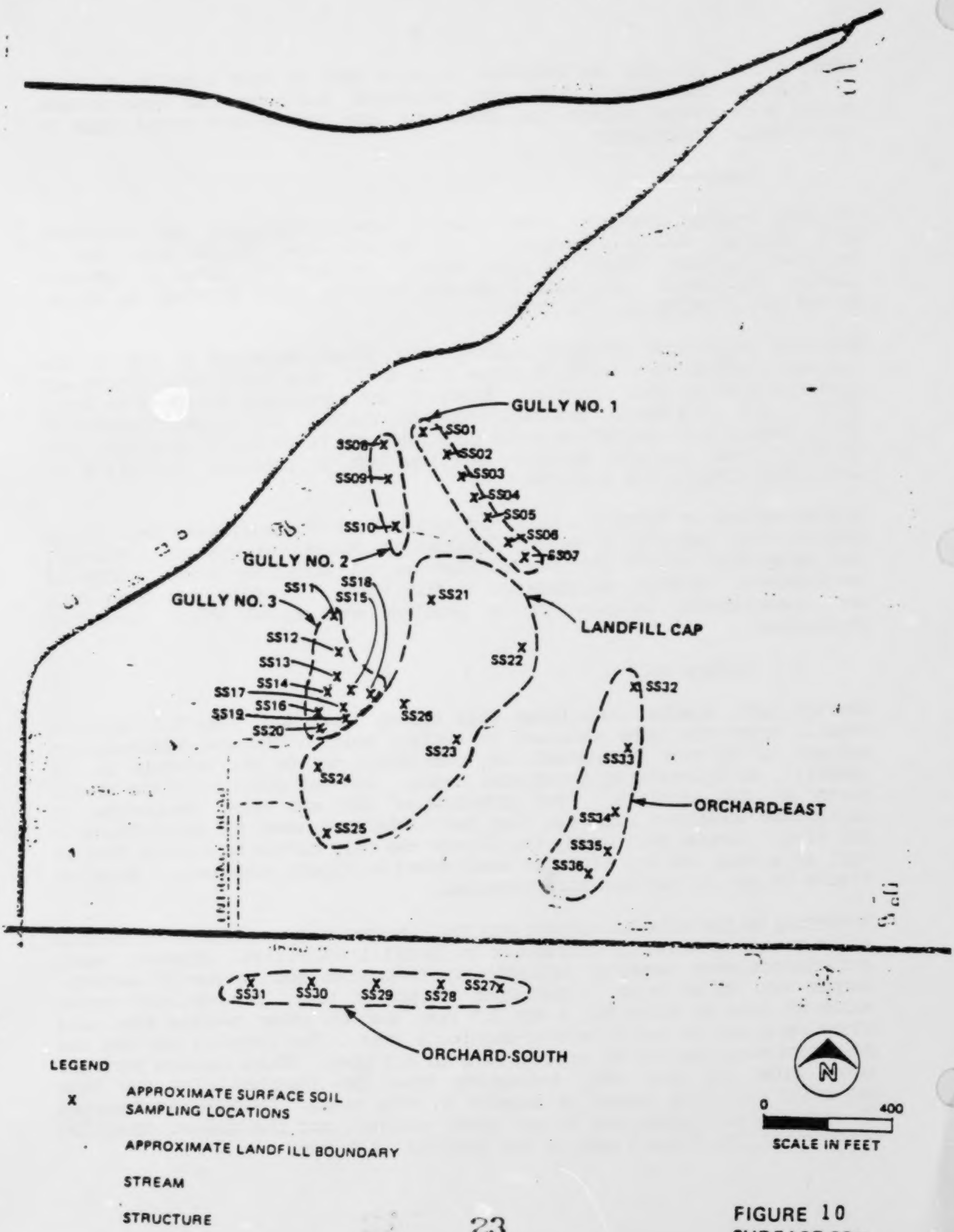

GULLY NO. 1
SS01
SS02
SS03
SS04
SS05
SS06
SS07
SS08
SS09
SS10
GULLY NO. 2
GULLY NO. 3
SS11
SS18
SS15
SS21
SS12
SS13
SS14
SS17
SS16
SS19
SS20
SS26
SS22
LANDFILL CAP
SS23
SS24
SS25
SS32
SS33
SS34
SS35
SS36
ORCHARD-EAST
SS31
SS30
SS29
SS28
SS27
ORCHARD-SOUTH
LEGEND
X APPROXIMATE SURFACE SOIL SAMPLING LOCATIONS
APPROXIMATE LANDFILL BOUNDARY
STREAM
STRUCTURE
N
0
400
SCALE IN FEET

FIGURE 10
SURFACE SOIL
SAMPLING LOCATIONS

5. Ambient Air And Gas Vent Emissions

The ambient air results indicate that only trace concentrations of relatively few organic contaminants were present along the north and west edge of the landfill. These contaminants were present in the background (up wind) sample and cannot be attributed to the Site. Carbon molecular sieve ambient air samples were taken at each location in Phase II and analyzed for vinyl chlorides. No vinyl chloride was detected in ambient air samples on or near the Site.

A wide variety of TCL organic compounds were detected in the gas vent emissions. Trends in the data between Phases I and II cannot accurately be stated because of the problems during laboratory analysis. In general, the variety and concentrations of organic compounds were smaller along the south-west edge of the Site (GV01, GV02, and GV03) and the north-east edge of the Site (GV09 and GV10) where the landfill is shallow. Refer to Figure 11 for all gas vent and ambient air sampling locations. Higher concentrations occur in areas of deeper fill; however, there are elevated concentrations in GV12, GV13, and GV15. This may indicate that the reported sludge pits were placed in these areas or that gas is migrating southeastward from areas of deeper fill.

Organic compounds detected in both gas vent emissions and groundwater of the upper aquifer include benzene, ethylbenzene, tetrachloroethene, toluene, and xylene. Vinyl chloride was detected at 106,000 ppb in GV06 in Phase I. The highest concentration in Phase II was 2,900 ppb in GV12.

E. Summary of Site Characteristics

The TCL organic and inorganic constituents detected during both phases of remedial investigation are summarized in Table 2. Monitoring wells, residential wells, surface water, sediment, ambient air, and landfill gas vent emissions were sampled during both phases; surface soil was sampled only during Phase II. The following generalizations can be made based on the chemical analyses:

- A contaminant plume extends north and northwest of the landfill, and monitoring well chemical data indicate little change in type or amount of contamination from Phase I to Phase II. The contaminant plume appears to extend from the landfill to Inman Road.

- Residential wells contained a variety of contaminants in Phase I, and the State of Michigan has since replaced two wells. Phase II data suggest that none of the existing residential wells in the area contain Site-related contaminants; however, the aquifers where the two wells were abandoned could still be contaminated.

- Surface water and sediment contain low levels of Site-related contaminants, especially inorganic and semi-volatile organic constituents that tend to accumulate. Contamination of these

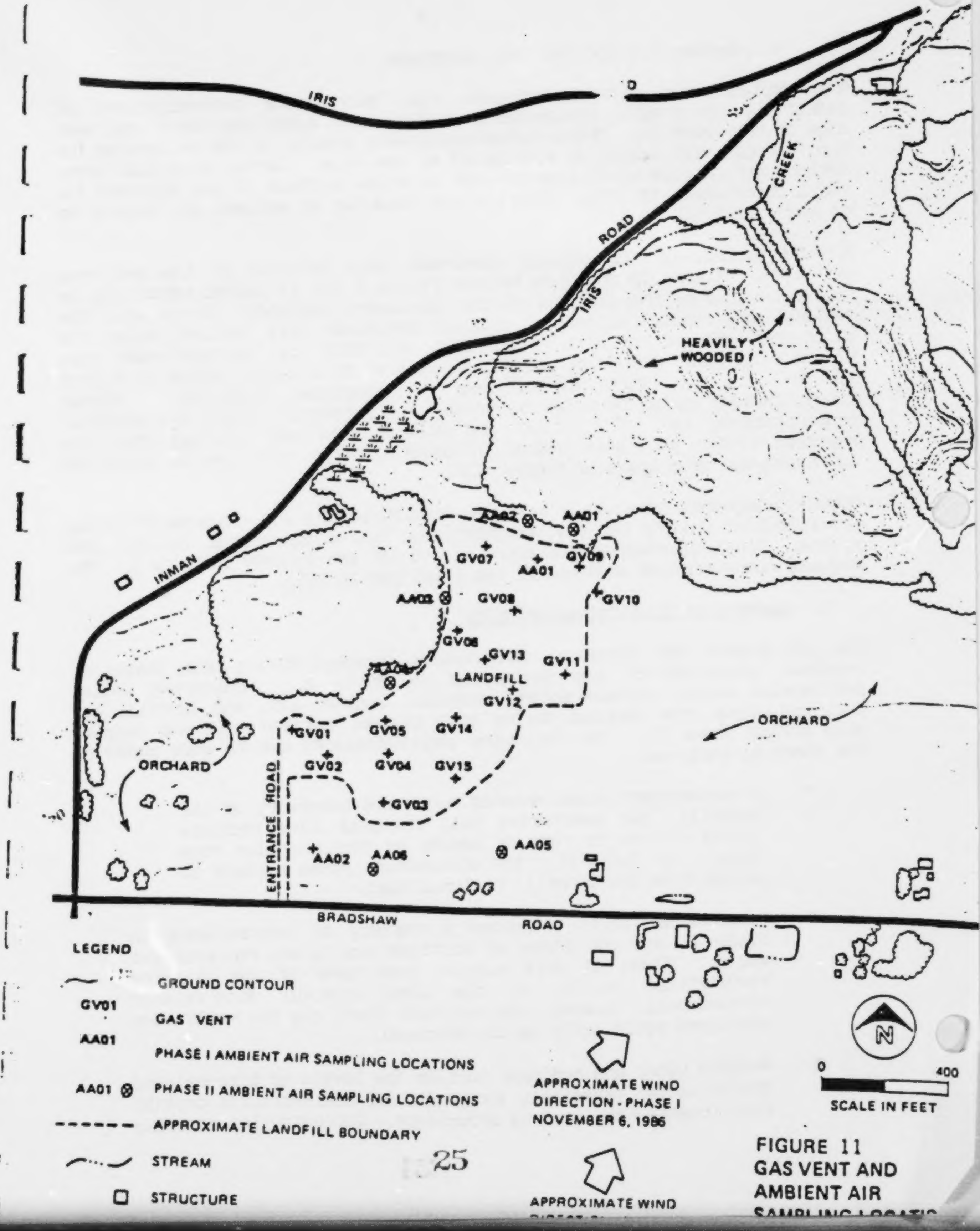

IRIS
ROAD
IRIS
ROAD
CREEK
HEAVILY WOODED
INMAN
AA02
AA01
GV07
AA01
GV09
AA03
GV08
GV10
GV06
GV13
GV11
AA04
LANDFILL
GV12
ORCHARD
ORCHARD
GV01
GV05
GV14
GV02
GV04
GV15
GV03
ENTRANCE ROAD
AA02
AA06
AA05
BRADSHAW
ROAD
LEGEND
GROUND CONTOUR
GV01
GAS VENT
AA01
PHASE I AMBIENT AIR SAMPLING LOCATIONS
AA01 ⊗
PHASE II AMBIENT AIR SAMPLING LOCATIONS
APPROXIMATE LANDFILL BOUNDARY
STREAM
STRUCTURE
APPROXIMATE WIND DIRECTION - PHASE I NOVEMBER 6, 1986
APPROXIMATE WIND
N
0
400
SCALE IN FEET

FIGURE 11
GAS VENT AND
AMBIENT AIR
SAMPLING LOCATI

media is limited to the headwaters of Iris Creek and Babbin Pond.

- Surface soil chemical data do not clearly indicate areas of landfill attributable contamination because background samples contained a variety of volatile organic compounds, pesticides, and inorganic contaminants.

- Landfill gas vent emissions contain chlorinated hydrocarbons and benzene, ethylbenzene, xylene, and toluene. These compounds may be indicative of the industrial sludges and liquids reportedly disposed of on-site because they were also detected at low concentrations in the contaminant plume north of the Site.

- Off-site air quality is not affected by the landfill according to off-site ambient air sampling.

F. CERCLA Enforcement

Notice letters informing potentially responsible parties (PRPs) of their potential liabilities and offering them the opportunity to perform the RI/FS were mailed via certified mail in August of 1985 to six PRPs, including the Site's owners, operators and waste generators. On September 6, 1985, the U.S. EPA decided to use Federal funds to conduct the RI/FS due to the PRPs refusal to participate. The U.S. EPA contracted with CH2M Hill to conduct the RI/FS under contract number 68-01-7251, work assignment number 006-5LE3.0.

Negotiations for the remedial design/remedial action (RD/RA) with the PRPs are presently proceeding according to the U.S. EPA general guidances and policies.

III. COMMUNITY RELATIONS

A RI/FS public meeting was held on November 13, 1986 to inform the local residents of the Superfund process and the work to be conducted under the RI. No major issues were raised by the community at this meeting.

An information repository has been established at the Ludington Library, at 217 E. Ludington in Ludington, Michigan. According to Section (k)(1) of CERCLA, the Administrative Record is available to the public at the Ludington Library.

The draft FS and the Proposed Plan were available for public comment from August 8, 1988 to August 31, 1988. A public meeting was held on August 17, 1988 to present the proposed plan and FS. Comments received during that public comment period and the U.S. EPA's responses are included in the attached Responsiveness Summary. The provisions of Sections 113(k)(2)(i-v) and 117 of CERCLA have been satisfied.

IV. SCOPE OF THE FEASIBILITY STUDY

The exposure pathways and associated risks from hazardous substances at the Site are addressed in the Site risk assessment in the RI Report and are summarized in the FS Report and in this Record of Decision Summary. On the basis of the exposure pathways and risks identified by the risk assessment, two operable units or pathways were selected at the Mason County Landfill Site: 1) landfill contents, and 2) groundwater.

> **The landfill contents operable unit** addresses all materials contained beneath the existing Site cap, such as general refuse, sludges, possible buried drums and the underlying soil contaminated by leaching. The landfill contents operable unit also addresses gas generated by the decomposing buried waste. The general remedial action goals for the landfill contents operable unit are to prevent direct contact with contaminant sources and to minimize future release of contaminants.
>
> **The groundwater operable unit** addresses the shallow and deep aquifers. The general remedial action goals for the groundwater operable unit are to minimize migration of contaminants in groundwater and to prevent exposure to contaminants in residential wells.

Surface water, sediment, and surface soil are not addressed as separate operable units. Although potential risks to public health and the environment were identified for those media, based on conservative exposure estimates, the estimated risks are not sufficiently high to warrant remedial action. Contamination of surface water and sediments is mainly the result of the discharge of contaminated groundwater to the wetlands area and Babbin Pond. Contaminant concentrations in those areas would be reduced if actions were taken to minimize the leaching of contaminants to the groundwater or to prevent migration of contaminated groundwater to these areas. These issues are addressed by the landfill contents and groundwater operable units.

Based on the information developed on the Mason County Landfill Site, U.S. EPA believes that the best approach to this Site is to separate the two operable units, landfill contents and groundwater, into two separate remedial actions. This approach is cost effective and consistent with a permanent remedy.

The alternative chosen by the U.S. EPA in this Record of Decision primarily addresses the landfill contents operable unit and defers the decision on the groundwater operable unit until more information is available.

The alternative chosen in this ROD is considered an interim remedy and is consistent with the eventual final remedial action for this Site. Based on available information, the U.S. EPA believes that the selected alternative for the landfill contents operable unit will meet the previously mentioned general remedial action goals for the landfill contents operable unit. The selected alternative is cost effective as it may greatly reduce the extent of future groundwater remediation. The specific components and evaluation criteria of the chosen interim remedial alternative are detailed later in this document.

Another Proposed Plan and ROD will be issued at the conclusion of the groundwater operable unit to announce and select a final remedy for this Site. Currently there is not enough data to select an appropriate remedy to address the groundwater contamination. More data is needed to define the extent of contamination, evaluate the effectiveness of an upgraded cap, track the concentration of contaminants in groundwater over time, further define the relationships between the identified aquifers and further investigate the relationship between the shallow aquifer and the surface water bodies near the Site. Further groundwater monitoring along with surface water, sediment and gas vent sampling will be conducted to evaluate the requirements for the groundwater operable unit, and the effectiveness of the chosen alternative for the landfill contents operable unit.

V. SITE RISK ASSESSMENT SUMMARY

Within the RI, a Risk Assessment chapter details a baseline risk assessment that addresses the potential threats to public health and the environment from the Site associated with the no action alternative.

The potential exposure pathways, the means by which contaminants may move from sources to receptors under both current and potential future land use conditions, were identified in the exposure assessment. After evaluation of Site conditions, the following pathways were identified as having potential to be completed under the no action alternative and were addressed in the risk assessment:

- * The release of contaminants from the landfill to the groundwater, the migration of these contaminants to the residential wells downgradient from the Site, and subsequent human exposure through groundwater use.
- * The trespass of people onto the Site where they might come into direct contact with contaminants present on the ground surface.
- * The release of contaminants from the landfill gas vents to the air where they could be inhaled by Site trespassers.
- * The release of contaminants by groundwater discharge to the wetlands, where people or wildlife could come into contact with them.
- * The future development of the Site resulting in direct contact with contaminants unearthed during excavation work.
- * The future installation of residential wells on-site or in areas adjacent to the Site, resulting in exposure to contaminants in the groundwater.

The following exposure pathways were not considered to be significant because of prevailing Site conditions:

- * Exposure of people through fish consumption. Few contaminants were found in upstream locations (Babbin Pond). Iris Creek is not deep enough to support large fish. There is no evidence that contaminants have migrated from the Site to the Pere Marquette River.
- * Exposure of off-site residents through inhalation of contaminants released from the landfill gas vents. The contaminants will be substantially diluted by mixing with air.

Potential hazards to human health from the Site were evaluated for both carcinogenic and noncarcinogenic risks. Concentrations of contaminants in groundwater were also compared to drinking water standards and criteria. Human health risks for the Site are summarized in Table 5.

Table 5 indicates the contaminants of concern at this Site for each exposure pathway. In summarizing the exposure assessment, Table 5 mentions the estimated potential carcinogenic and noncarcinogenic risks at this Site. More detailed explanations and rationales involving methods to determine risk at the Site are located within the RI Report. Risks associated with background (areas not believed to be influenced by the landfill) levels are not addressed. Potential environmental concerns associated with the Site are only addressed in a general qualitative method since no formal evaluation of the plant and animal communities on-site or in surrounding areas were determined to be necessary during the RI.

The RI report further details the baseline assessment for the Site and the baseline summary indicates the following areas of concern:

- * The use of groundwater from wells located between the landfill and Inman Road may result in adverse health effects. This concern comes from the detection of carcinogens in monitoring wells at concentrations greater than those associated with a 1 x 10^{-7} excess lifetime cancer risk, the presence of noncarcinogens at levels higher than those needed to exceed reference dose values, and the presence of two chemicals at levels that exceed MCLs.
- * The ingestion of lead found in one surface soil sample would exceed the reference dose value. However, all other detections of lead in soil were below a level of concern.
- * The release of vinyl chloride from gas vents to the atmosphere is a concern only under conservative exposure conditions and only for individuals who come onto the Site.

TABLE 5 (Page 1 of 2)
Summary of Risk Assessment

Exposure Point	Exposure Pathway	Exposed Population	Risk Characterization Summary	Comments
Drinking water, offsite residential well	Leaching; groundwater migration, ingestion	Residents	RfDs exceeded in one residential well for cadmium, lead, and zinc (Phase I). Excess Lifetime Cancer Risk = 3×10^{-6} to 7×10^{-7} (Phase I)	Excess Lifetime Cancer Risk assumes a 70-year exposure to the highest detected concentrations in the well. In Phase II, no carcinogens were detected in any residential wells. The decline in contaminant detections in Phase II is due in part to the replacement of two contaminated wells by the State of Michigan.
Drinking water, onsite well screened in upper aquifer	Leaching; ingestion	Future site occupants	RfDs exceeded by cadmium, lead, and zinc using maximum detected concentrations. No RfDs exceeded using average concentrations. Total Excess Lifetime Cancer Risk = 1×10^{-3} (Phase I--cancer risk due mostly to 1,1-dichloroethane) 3×10^{-5} (Phase II--cancer risk due mostly to benzene)	Total Excess Lifetime Cancer Risk assumes a 70-year exposure to the highest detected concentrations of all carcinogens in all monitoring wells. Exposure setting assumes that onsite residential development will occur and that drinking supply wells will be installed. This is unlikely because there is little pressure for residential development in the area, the land is zoned for agricultural use, and the property is owned by a public agency (Mason County DPW).
Drinking water, onsite well screened in lower aquifer	Leaching; ingestion	Future site occupants	No RfDs exceeded. Total Excess Lifetime Cancer Risk = 7×10^{-6} (Phase II--cancer risk due to benzene, 1,2-dichloroethane, and tetrachloroethene)	Total Excess Lifetime Cancer Risk assumes a 70-year exposure to the highest detected concentrations of all carcinogens in all monitoring wells. Exposure setting assumes that onsite residential development will occur and that drinking supply wells will be installed. This is unlikely because there is little pressure for residential development in the area, the land is zoned for agricultural use, and the property is owned by a public agency (Mason County DPW).
Surface water	Leaching; groundwater migration; groundwater discharge to surface water; ingestion or direct contact	Trespassers	Risks not quantified.	Exposure by ingestion or direct contact limited by small size of nearby population. Also, Iris Creek is too shallow for swimming and access to Bubble Pond limited to trespassers. Human exposure from ingestion of contaminated aquatic organisms is unlikely.
	Leaching; groundwater migration; groundwater discharge to surface water	Aquatic organisms	Chronic aquatic criteria exceeded for total chromium and mercury (Phase I only). Criteria not exceeded for any Phase II sample.	Total chromium concentration more likely to be in the trivalent form than hexavalent form because of reducing nature of surface water in site area.
Surface soil	Ingestion	Trespassers	RfD exceeded for lead (child exposure) if one high sample is included. RfD not exceeded if that sample is excluded. Total Excess Lifetime Cancer Risk = 5×10^{-10} (using highest detected concentrations)	Exposure setting is restricted to site trespassers (e.g., hikers or playing children) and it assumes ingestion of 0.1 gram/day of soil (noncarcinogenic effects) and 0.1 gram/day for 36 wk/yr for 5 years (carcinogenic effects). High lead concentration detected at only one sampling point may be representative of a small, localized area of soil. Average onsite concentrations of contaminants were below upper background concentrations (mean + 3 standard deviations) except for nickel and vanadium.

TABLE 5 (Page 2 of 2)
Summary of Risk Assessment

Exposure Point	Exposure Pathway	Exposed Population	Risk Characterization Summary	Comments
Sediment	Ingestion	Trespassers	No RfDs exceeded. Total Excess Lifetime Cancer Risk = 7×10^{-10}	Exposure setting is the same as for surface soils.
Air	Inhalation	Trespassers	No RfDs exceeded. Total Excess Lifetime Cancer Risk = 5×10^{-6} (Phase I--cancer risk due mostly to vinyl chloride) 3×10^{-7} (Phase II--cancer risk due mostly to vinyl chloride)	Exposure setting is restricted to site trespassers (e.g., hikers or playing children) and it assumes inhalation of diluted gas vent emissions for 5 min/day (noncarcinogenic effects) and 5 min/day for 5 years (carcinogenic effects). Gas vent concentrations were diluted 900-fold to simulate a 30-foot distance from the vent.
		Residents	Risk not quantified; no contaminants detected in offsite ambient air sampling.	Using exposure setting similar to that for site trespassers, the gas vent concentrations would be diluted by 50,000-fold to simulate a 400-foot distance from a gas vent to the nearest residence.

VI. DESCRIPTION OF REMEDIAL ALTERNATIVES

A. Screening of Alternatives

1. Screening Criteria and Goals

Screening: Numerous technologies and process options were evaluated for applicability at this Site. These technologies and process options were screened initially for the following to determine if further consideration was warranted:

* Inability to achieve remedial action goals.

* Failure to meet federal or state ARARs.

* Impracticable nature or difficulty of implementation given Site contaminants and physical conditions.

Figures 12 and 13 illustrate the initial evaluation of the technologies and process options for the landfill contents and groundwater operable units.

Goals: The general remedial action goals for the landfill contents operable unit are to prevent direct contact with contaminant sources and to minimize future release of contaminants. Specific remedial action goals are:

1. To prevent direct contact with landfill sources that have contaminant levels exceeding target concentrations for protection of public health from the effects of noncarcinogenic contaminants (based on reference doses), or excess lifetime cancer risk in the range of 1 x 10^{-4} to 1 x 10^{-7}.

2. To prevent contaminant migration from landfill sources to drinking water aquifers that would contaminate these aquifers to levels:

   * Greater than maximum contaminant levels (MCLs);

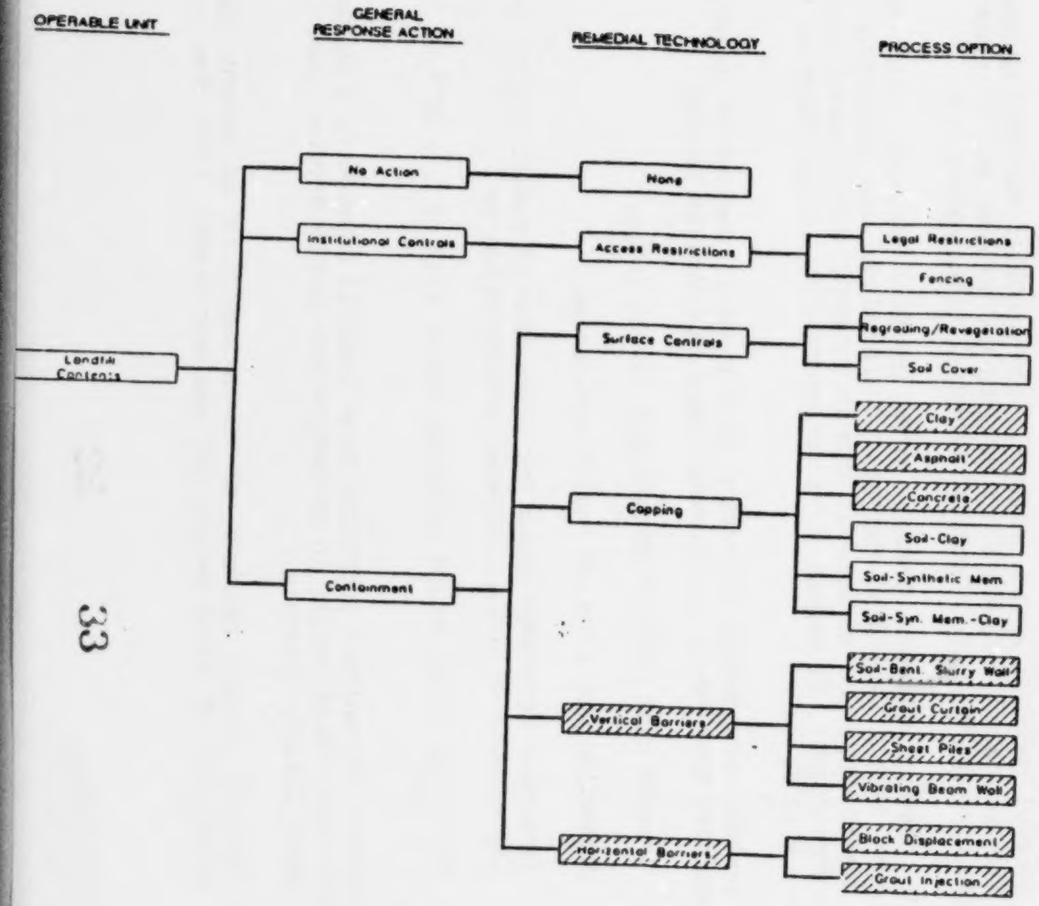
   * Exceeding the lifetime health advisories;

   * Exceeding reference doses for protection of public health from the effects of noncarcinogenic contaminants; or

   * Resulting in an excess lifetime cancer risk of 1 x 10^{-4} to 1 x 10^{-7}.

3. To prevent contaminant migration from landfill sources to a surface water body that would result in contamination levels greater than the Ambient Water Quality Criteria.

4. To control future releases of contaminants to an extent that ensures protection of human health and the environment (SARA Sec. 121 (d))


OPERABLE UNIT
GENERAL RESPONSE ACTION
REMEDIAL TECHNOLOGY
PROCESS OPTION
Landfill Contents
No Action
Institutional Controls
Containment
None
Access Restrictions
Surface Controls
Capping
Vertical Barriers
Horizontal Barriers
Legal Restrictions
Fencing
Regrading/Revegetation
Soil Cover
Clay
Asphalt
Concrete
Soil-Clay
Soil-Synthetic Mem.
Soil-Syn. Mem.-Clay
Soil-Bent. Slurry Wall
Grout Curtain
Sheet Piles
Vibrating Beam Wall
Block Displacement
Grout Injection

PROCESS OPTION	DESCRIPTION	APPLICABILITY
None		NCP requires No Action to be carried through to detailed analysis of alternatives
Legal Restrictions	All deeds for property within potentially contaminated areas would include limitations on use of property	Potentially viable
Fencing	Fence would be installed around landfill area and repaired as necessary	Potentially viable
Regrading/Revegetation	Fill depressions and mechanically reshape existing landfill contours to manage surface water. Establish vegetative cover to reduce erosion	Potentially viable
Soil Cover	Compacted soil with vegetative cover placed over existing clay cover.	Potentially viable
Clay	Compacted clay barrier placed over existing clay cover	Site already has clay cap. This option addressed by regrading and revegetation
Asphalt	Spray application of a layer of asphalt over landfill	Relief of landfill prevents application to steep slopes without extensive regrading
Concrete	Concrete slab constructed over landfill.	Relief of landfill would prevent installation of slab to steep slopes
Soil-Clay	Compacted clay barrier covered with soil layers to provide erosion and moisture control.	Potentially viable
Soil-Synthetic Mem.	Impermeable synthetic membrane covered with soil layers to provide erosion and moisture control.	Potentially viable
Soil-Syn. Mem.-Clay	Compacted clay and synthetic membrane barrier covered with soil layers to provide erosion and moisture control.	Potentially viable
Soil-Bent. Slurry Wall	Trench is excavated while filled with a bentonite water slurry. Trench is backfilled with a soil-bentonite or cement-bentonite mix	Discontinuous confining layers to key into, and strong vertical gradients make a hanging wall ineffective
Grout Curtain	Pressure injection of grout in a regular overlapping pattern of drilled holes	Discontinuous confining layers to key into, and strong vertical gradients make a hanging wall ineffective
Sheet Piles	Driven steel sheet piling	Discontinuous confining layers to key into, and strong vertical gradients make a hanging wall ineffective
Vibrating Beam Wall	Vibratory force used to advance steel beam into ground and injection of relatively thin wall of cement or bentonite as beam is withdrawn	Discontinuous confining layers to key into, and strong vertical gradients make a hanging wall ineffective
Block Displacement	Controlled injection of slurry in notched injection holes to produce horizontal barrier beneath the contaminants	Difficult to determine integrity of barrier. Not effective because of the absence of continuous stratigraphic units beneath landfill
Grout Injection	Pressure injection of grout at depth through closely spaced drilled holes	Difficult to determine integrity of barrier. Not effective because of the absence of continuous stratigraphic units beneath landfill

END

▨ Not Carried Forward

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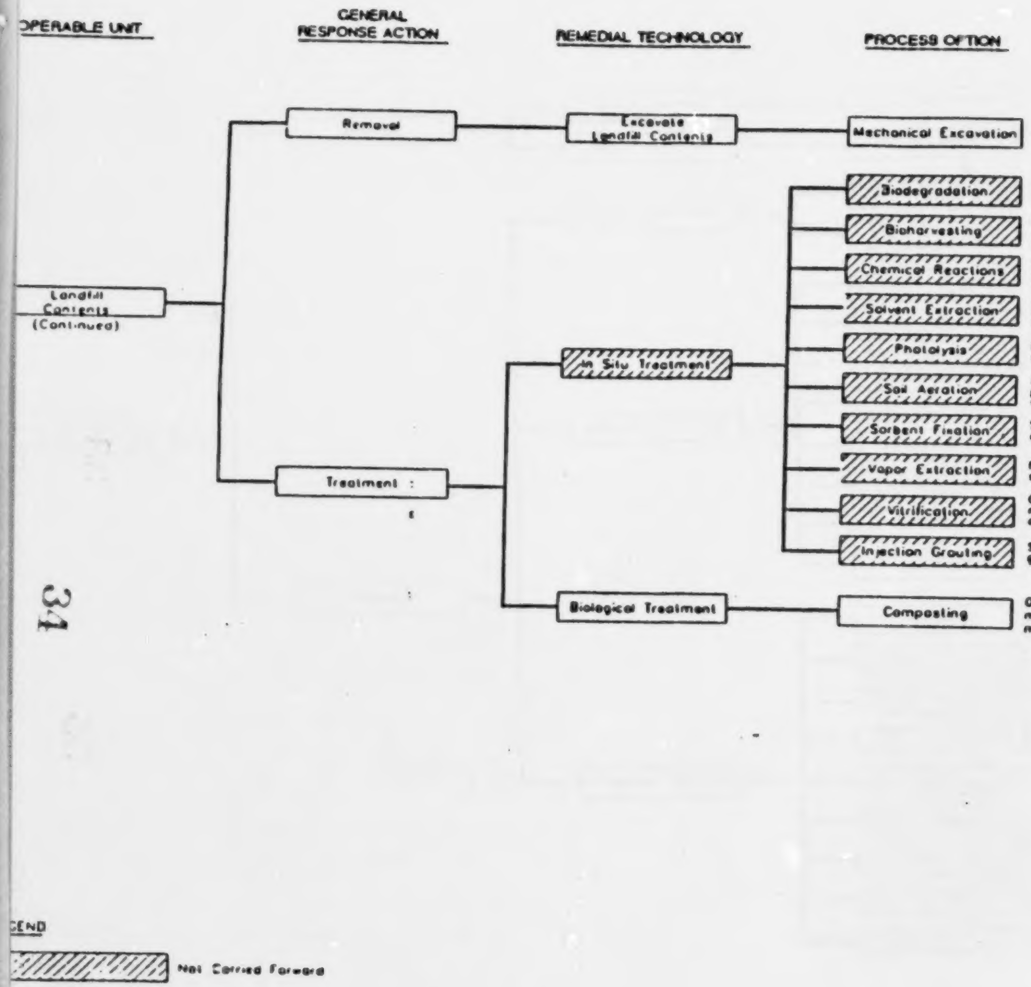
FIGURE 12 (PAGE 1 OF 3)
APPLICABLE REMEDIAL
TECHNOLOGIES
AND PROCESS OPTIONS
FOR THE LANDFILL CONTENTS
MASON COUNTY LANDFILL FS

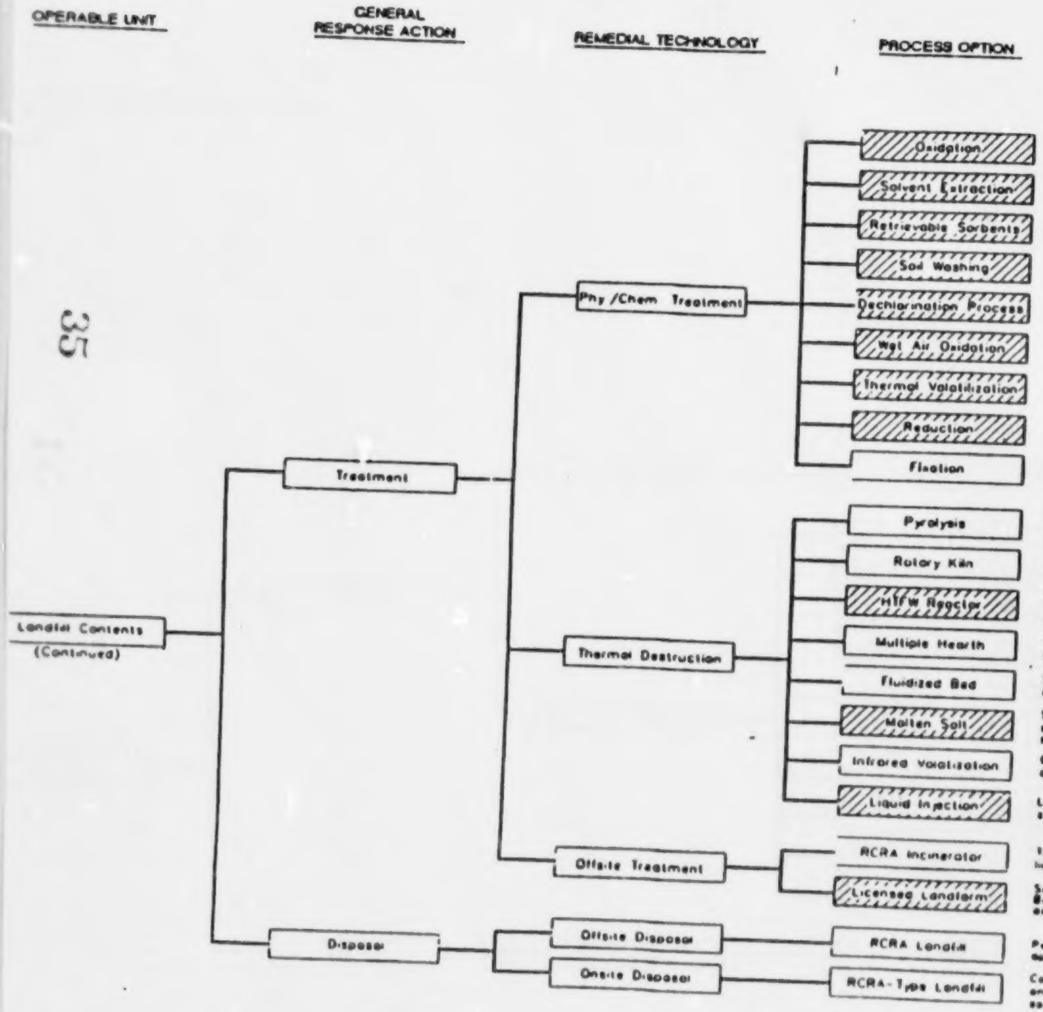

OPERABLE UNIT
GENERAL RESPONSE ACTION
REMEDIAL TECHNOLOGY
PROCESS OPTION
Landfill Contents (Continued)
Removal
Treatment :
Excavate Landfill Contents
In Situ Treatment
Biological Treatment
Mechanical Excavation
Biodegradation
Bioharvesting
Chemical Reactions
Solvent Extraction
Photolysis
Soil Aeration
Sorbent Fixation
Vapor Extraction
Vitrification
Injection Grouting
Composting
LEGEND
Not Carried Forward

OPERABLE UNIT	GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	APPLICABILITY
Landfill Contents (Continued)	Removal	Excavate Landfill Contents	Mechanical Excavation	Construction equipment such as a backhoe or dragline crane remove refuse	Potentially viable
	Treatment :	In Situ Treatment ▨	Biodegradation ▨	Soil seeded with micro-organisms and nutrients to allow biological degradation	Shallow treatment only. Added nutrients may present threat to groundwater quality
			Bioharvesting ▨	Use of plant and animal species to accumulate contaminants in their tissues. Species are harvested and disposed of	Not applicable to all types of contaminants found onsite, especially VOCs that will not accumulate
			Chemical Reactions ▨	Application via underground injection of chemicals such as ozone, hydrogen peroxide, or permanganate for degradation of organics	Not applicable to all types of contaminants found onsite. Added chemicals may pose a threat to groundwater. Side reactions may produce other hazardous substances
			Solvent Extraction ▨	Application of solvent either via surface flooding or injection. Collection of extract at wells followed by treatment	Control of migrating solvents not assured. Solvent may become a groundwater contaminant. Not applicable to all types of contaminants found onsite
			Photolysis ▨	Photodegradation of soil contaminants via solar energy and the application of solvents	Shallow penetration depth. Not applicable to types of contaminants found onsite
			Soil Aeration ▨	Aeration of soil via injection wells used to promote microbial biodegradation and to strip volatile organics from soil	Not applicable to all types of contaminants onsite or drummed waste, if present
			Sorbent Fixation ▨	Soil mixed with sorbent material which can concentrate and fix contaminants	Not applicable to all types of contaminants onsite. Does not chemically immobilize contaminants
			Vapor Extraction ▨	Removal of VOCs by application of vacuum on soils through a system of wells	Not applicable to all types of contaminants onsite or drummed waste, if present
			Vitrification ▨	Contaminated material is fused into glassy stable matrix by heating it in place with an electric current	Not applicable to the landfill contents because of their heterogeneous nature. High BTU and metal proportion of landfill contents suggests possibility for fire and short circuiting, respectively
			Injection Grouting ▨	Stabilization of contaminated material by injecting grout into the ground through well points	Not applicable to the large volume and variety of landfill contents.
		Biological Treatment	Composting	Organic materials placed in controlled environment with addition of nutrients and air to aid microbial degradation of organics	Potentially viable

LEGEND

▨ Not Carried Forward

FIGURE 12 (PAGE 2 OF 3)
APPLICABLE REMEDIAL
TECHNOLOGIES
AND PROCESS OPTIONS
FOR THE LANDFILL CONTENTS
MASON COUNTY LANDFILL [illegible]

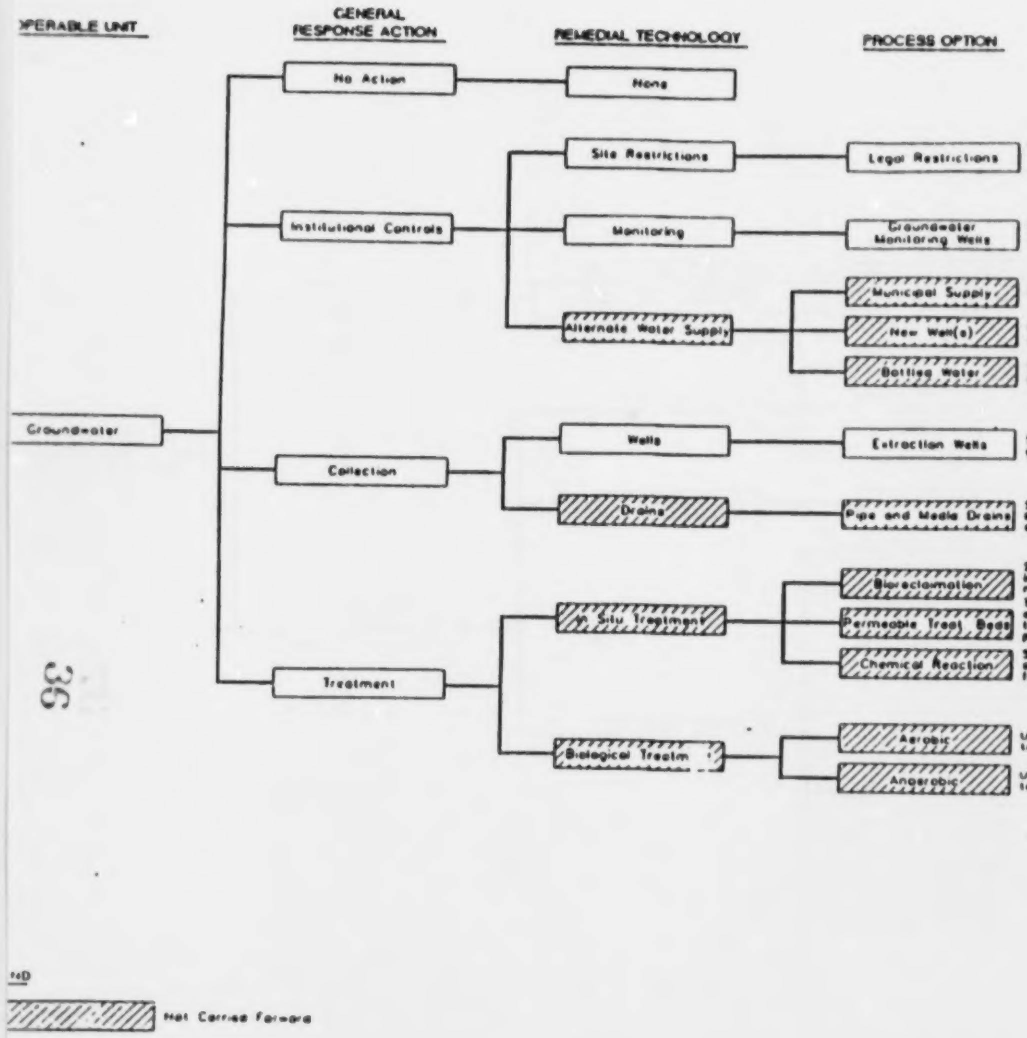


PROCESS OPTION	DESCRIPTION	APPLICABILITY
▨ Oxidation	An oxidizer such as ozone, hydrogen peroxide, or permanganate introduced into a contactor where it mixes with soil and oxidation occurs	Side reactions may produce other hazardous substances. Not suited for treatment of solids or odd sizes of materials
▨ Solvent Extraction	Solvent is introduced into a contactor where it mixes with solids. Extract is collected and later treated	Not applicable to all types of contaminants found onsite. Not practical on a large scale. Not suited for treatment of solids of odd sizes of materials
▨ Retrievable Sorbents	Absorbent materials with ability to concentrate contaminants are mixed with soil. Use of magnetic particles in sorbents allows their collection and removal	Not applicable to types of contaminants found onsite. Not suited for treatment of solids or odd sizes of materials
▨ Soil Washing	Use of water or steam to wash or volatilize and flush contaminants from soil or gravel	Not technically practical for removal of organics found in site soil or landfill contents. Not suited for treatment of odd sizes of materials
▨ Dechlorination Process	Sodium reagent used to strip chlorine atoms from chlorinated hydrocarbons	Applicability limited to few contaminant types that may not exist in large quantity onsite
▨ Wet Air Oxidation	Oxidation of organics in a reactor under high temperature and pressure	Not technically practical on large scale for destruction of contaminant types found onsite
▨ Thermal Volatilization	VOC volatilization in a soil drying unit	Applicability limited to few contaminant types that may not exist in large quantity onsite
▨ Reduction	Reduction of chlorinated organics and Cr^{6+} using SO_2 and ferrous ammonium sulfide	Applicability limited to few contaminant types that may not exist in large quantity onsite
Fixation	Wastes are excavated and mixed with sulfide, lime, cement, molten glass, or various proprietary products for solidification and stabilization	Potentially viable
Pyrolysis	Solids and liquids are burned in an oxygen deficient atmosphere to produce char residue and volatile organic gases which are then incinerated in an after burner	Potentially viable
Rotary Kiln	Solids and liquids are fed into a horizontally rotating cylinder designed for uniform heat transfer	Potentially viable
▨ HTFW Reactor	Solids and liquids are fed into a high temperature fluid wall reactor where heating is supplied by large electrodes in a refractory lined vessel	Requires very large electric load
Multiple Hearth	Solids and liquids are burned in a reactor consisting of a rotating central shaft and a series of hot hearths	Potentially viable
Fluidized Bed	Solids and liquids are added to a hot agitated bed of sand where heat transfer and combustion occur	Potentially viable
▨ Molten Salt	Solids and liquids are fed into a furnace with a molten salt bed acting as a catalyst and dispersing medium for incinerating wastes	Appropriate for highly toxic inorganic or halogenated waste
Infrared Volatilization	Combustion of solids in a horizontal rectangular chamber using electric infrared heat	Potentially viable
▨ Liquid Injection	Liquid wastes are atomized with high pressure air or steam and burned in suspension	Appropriate only for liquids and vapor wastes with low ash content
RCRA Incinerator	Thermal destruction of contaminated solids and liquids in approved RCRA-permitted incinerator	Potentially viable
▨ Licensed Landfarm	Soils spread over land in licensed landfarm. Biological degradation with micro-organisms in aerated and nutrient-rich soils	Not applicable to wide variety of contaminants
RCRA Landfill	Permanent storage of contaminated soils at an approved RCRA-permitted landfill	Potentially viable; however, RCRA land ban prohibits landfilling materials containing solvents
RCRA-Type Landfill	Construct a RCRA-type containment structure onsite for permanent storage of contaminated soils	Potentially viable

END

▨ Not Carried Forward

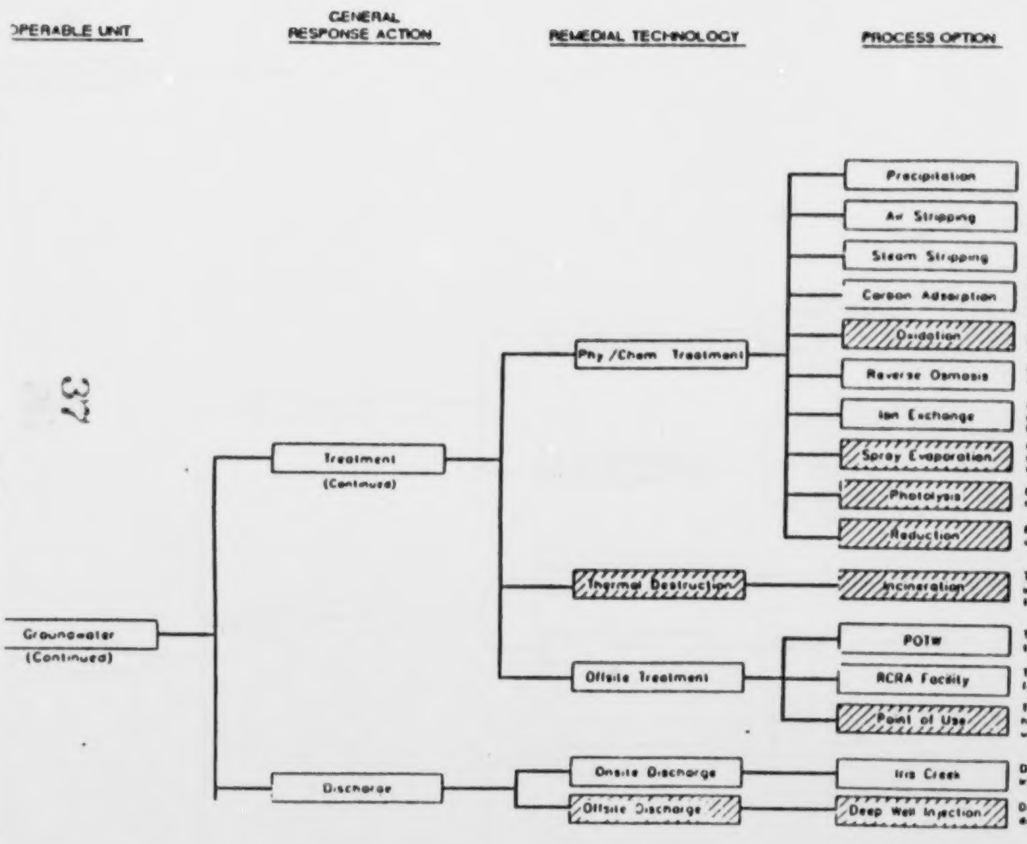
FIGURE 12 (PAGE 3 OF 3)
APPLICABLE REMEDIAL
TECHNOLOGIES
AND PROCESS OPTIONS
FOR THE LANDFILL CONTENTS
MASON COUNTY LANDFILL [illegible]



OPERABLE UNIT
GENERAL RESPONSE ACTION
REMEDIAL TECHNOLOGY
PROCESS OPTION
Groundwater
No Action
Institutional Controls
Collection
Treatment
None
Site Restrictions
Monitoring
Alternate Water Supply
Wells
Drains
In Situ Treatment
Biological Treatm
Legal Restrictions
Groundwater Monitoring Wells
Municipal Supply
New Well(s)
Bottled Water
Extraction Wells
Pipe and Media Drains
Bioreclamation
Permeable Treat. Beds
Chemical Reaction
Aerobic
Anaerobic
ND
Not Carried Forward

PROCESS OPTION	DESCRIPTION	APPLICABILITY
None		NCP requires No Action to be carried through to detailed analysis of alternatives
Legal Restrictions	Legal restrictions for property within potentially contaminated areas would include limitations on use of property	Potentially viable
Groundwater Monitoring Wells	Downgradient monitoring wells periodically sampled and tested	Potentially viable
▨ Municipal Supply	Connect to nearest municipal water supply line	Residential wells downgradient of landfill are not contaminated. Action not necessary at present
▨ New Well(s)	Install new wells in area(s) near affected wells and outside contaminated plume	Residential wells downgradient of landfill are not contaminated. Action not necessary at present
▨ Bottled Water	Supply bottled drinking water to residents with affected wells	Residential wells downgradient of landfill are not contaminated. Action not necessary at present
Extraction Wells	Series of wells to extract contaminated groundwater for treatment or disposal	Potentially viable
▨ Pipe and Media Drains	System of perforated pipe laid in trenches and backfilled with permeable media to intercept and collect contaminated groundwater	Not applicable due to the discontinuity and nature of hydrostratigraphic units and depth of contaminated media
▨ Bioreclamation	System of injection and extraction wells used to inject aerated water seeded with bacteria and nutrients to biodegrade organic contaminants.	Groundwater temperature too cold to support bacterial growth
▨ Permeable Treat. Beds	Trenches downgradient of site backfilled with activated carbon, lime, or ion exchange resins, to remove contaminants as groundwater passes through	Groundwater contamination too deep for construction of trench
▨ Chemical Reaction	System of injection wells used to inject oxidizers such as ozone, permanganate or hydrogen peroxide for degradation of organics	Side reactions may produce hazardous products
▨ Aerobic	Use microorganisms in an aerobic environment to degrade organics	Insufficient organics content to sustain growth of microorganisms
▨ Anaerobic	Use microorganisms in an anaerobic environment to degrade organics	Insufficient organics content to sustain growth of microorganisms

FIGURE 13 (PAGE 1 OF 2)
APPLICABLE REMEDIAL
TECHNOLOGIES AND PROCESS
OPTIONS FOR GROUNDWATER
MASON COUNTY LANDFILL



PROCESS OPTION	DESCRIPTION	APPLICABILITY
Precipitation	Alteration of chemical equilibria to reduce solubility of the constituent	Potentially viable for inorganic contaminants
Air Stripping	Mixing of large volumes of air with water in a packed column or through diffused aeration to promote transfer of VOC's to air	Potentially viable for organic contaminants
Steam Stripping	Similar to air stripping except steam is pumped into stripping column to add heat in the promotion of VOC's from liquid to air	Potentially viable for organic contaminants
Carbon Adsorption	Passage of contaminated water over columns of activated carbon where contaminants adsorb onto the carbon surface	Potentially viable for organic contaminants and some inorganic contaminants
▨ Oxidation	Chemical oxidation of groundwater contaminants using an oxidizing agent such as peroxide, hypochlorite, chlorine gas, or ozone, or high temperature and pressure conditions	Not applicable to variety of compounds present. Side reactions and intermediates may be hazardous
Reverse Osmosis	Use of high pressure to force clean water through a membrane leaving contaminants behind	Potentially viable for inorganic contaminants
Ion Exchange	Contaminated water is passed through a bed of resin material where exchange of ions occurs between the bed and the water	Potentially viable for inorganic contaminants
▨ Spray Evaporation	Contaminated water sprayed into air where volatile compounds are transferred from the water. Large collection ponds receive spray water	Process difficult to control. Once airborne, contaminants may be carried offsite. Complete volatilization of some constituents is unlikely
▨ Photolysis	Photodegradation of contaminants using UV radiation or addition of polar solvents	Intermediates may be hazardous. Complete degradation of organics unlikely
▨ Reduction	Reduction of chlorinated organics and Cr^{6+} using sulfur dioxide or ferrous ammonium sulfide	Not applicable to types of contaminants present. Side reactions may produce hazardous products
▨ Incineration	Thermal destruction of organic contaminants using any one of many reactor types suited to handle aqueous wastes	Groundwater chemical characteristics and concentrations will not support combustion. Concentrations are too low to be considered as a fuel supplement
POTW	Transport groundwater to POTW for treatment	Potentially viable
RCRA Facility	Transport groundwater to RCRA-licensed facility for treatment and/or disposal	Potentially viable
▨ Point of Use	Treat groundwater at point of use with home ion exchange or carbon adsorption units	Residential wells downgradient of landfill are not contaminated. Action not necessary at present
Iris Creek	Discharge treated groundwater to Iris Creek	Potentially viable
▨ Deep Well Injection	Discharge contaminated groundwater to deep well injection system	Deep aquifer is mined locally for salt brines; deep well injection could harm this economic resource

END

▨ Not Carried Forward

FIGURE 13 (PAGE 2 OF 2)
APPLICABLE REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER
MASON COUNTY LANDFILL FS

5. To permanently and significantly reduce toxicity, mobility, or volume of hazardous substances (SARA Sec. 121 (b))

The general remedial action goals for the groundwater operable unit are to minimize migration of contaminants in groundwater and prevent exposures to contaminants in residential wells. Specific remedial action goals are:

1. To prevent exposure of receptors to contaminated groundwater.

2. To prevent migration of contaminants from the shallow and deep aquifers to off-site receptors that would result in exposure:

   * Greater than the MCLs;

   * Exceeding the lifetime health advisories;

   * Exceeding reference doses for protection of public health from the effects of noncarcinogenic contaminants; or

   * Exceeding a lifetime cancer risk of 1×10^{-4} to 1×10^{-7}.

3. To prevent migration of contaminants from the shallow aquifer to a surface water body that would result in contamination levels greater than the Ambient Water Quality Criteria.

The technologies and process options carried forward through the initial screening were evaluated further based on effectiveness, implementation, and cost.

1. Landfill Contents Operable Unit

The technologies and process options evaluated for the landfill contents operable unit and corresponding evaluation summaries are as follows:

a. Access Restrictions

Access restrictions are intended to prevent prolonged exposure to or direct contact with contaminants, to control future development and excavation, and to prevent the installation of water supply wells. These objectives would be accomplished by placing legal restrictions on the property and enclosing the Site with a fence. Access restrictions are an effective method of limiting public access, but they do not reduce the level of contamination and are not protective of the environment.

A Site fence with locking gates and warning signs can prevent access to the landfill by humans and some animals. Its effectiveness depends on future maintenance. This action can protect the integrity of the landfill cover or cap, and it helps prevent direct contact with contaminants. Fences are easily installed at low cost.

Legal restrictions would control the future use of property, and their effectiveness is dependent on continued implementation in the future. Legal restrictions are subject to changes in political jurisdictions, legal interpretation, and regulatory enforcement. However, if legal restrictions are properly implemented, they provide low cost protection against direct contact with contaminants and prohibit installation of water supply wells. Both legal restrictions and a Site fence at the Mason County Landfill Site would be effective for protecting human health, easy to implement, and low in cost. It was not possible to screen one in favor of the other because of their significantly different effects on remedial action at the Site, so both were carried forward for assembly into alternatives.

b. Containment

At the Mason County Landfill Site, containment would be limited to surface controls and capping. These technologies would be effective at minimizing the potential threat of direct contact with surface contaminants. They would address the issue of surface water management and could reduce surface infiltration. Some degree of protection against surface infiltration has already been achieved by the single layer clay cap installed in 1979 and upgraded in 1984-85. However, large settlements have created areas of ponded water and cracks along the landfill perimeter.

The existing clay cap can be incorporated into the final design of any of the contaminant technologies considered for the Site. The options range from a maintenance procedure (regrading and revegetation) to a multilayer cap with two low permeability barriers that are protected from the environment by overlying soil layers (soil-synthetic membrane-clay cap). The main difference between the technologies is the degree of protection provided for the low permeability layer.

Regrading and revegetation with a soil cover would reduce leachate generation, but, regrading and revegetation with a soil/clay cover would be more effective at reducing surface infiltration. Regular mowing and periodic inspection and maintenance would be required for either option. Maintenance would consist of filling depressions with soil and reseeding. Since the costs for both options would be low and both could be easily implemented, the regrading and revegetation option was carried forward because it would be more effective.

The capping options would be an improvement over regrading and revegetation because the low permeability barrier would be protected from environmental conditions that can create cracks. The soil-clay cap and the soil-synthetic membrane cap would have roughly equivalent performance, and the soil-synthetic membrane-clay cap would have the best performance. The technical feasibility of each cap does not vary greatly; routine maintenance would be similar and each cap would probably require replacement because of settlement cracking. It has not been demonstrated that the risk of contaminant release to the groundwater at this Site warrants the extra protection and concurrent high capital and replacement costs associated with the soil-synthetic membrane-clay cap. The lack of clear advantages or disadvantages between the other two capping options makes relative cost a valid screening criterion. Since clay is available within 10 miles of the Site, the soil clay cap could be constructed at less cost than the soil-synthetic membrane cap. Therefore, the soil-clay cap was retained for further evaluation.

Gases produced by decomposition of the landfill contents beneath the low permeability barrier layer would be vented to prevent the cap from cracking or gases from migrating off-site through the subsurface. Gases are currently vented to the atmosphere without treatment through a system of fifteen vents. The risk to the public associated with gas vent emissions was determined to be negligible outside the Site boundaries. A Site fence could adequately prevent the risk of direct contact with landfill gases without the need for an expensive gas collection and treatment system so a gas venting system similar to the existing system in conjunction with a Site fence has been considered with each containment option.

Figure 14 illustrates the cap configurations that were carried forward for assembly into alternatives for the Mason County Landfill Site. The anticipated frost depth was conservatively estimated to be 3 feet.

c. Removal

Under the removal response action, contaminated wastes would be excavated and disposed of or treated to reduce the potential risk associated with direct contact to contaminants and migration of contaminants to groundwater. Landfill contents can be excavated using backhoes or clamshells. Excavation and handling operations would vary because of the variety of wastes. Waste would be segregated into garbage, soil, sludges, and drums (if present) because different waste types require different handling, treatment, and disposal. All excavated areas would be backfilled with clean soil to a level consistent with the rest of the Site.

There is considerable risk of worker exposure to hazardous materials during excavation, including potential contact with hot spots (i.e., areas where sludges and liquids were deposited) or drummed liquids and contact with airborne contaminants. Dust and surface water runoff must be controlled during excavation to avoid or minimize potential off-site release and exposure.

Excavation would be an effective and reliable technology for the removal of contaminant sources at the Mason County Landfill Site. It would be protective of human health and the environment when combined with such response actions as treatment or disposal. However, it would be difficult to implement and have a high capital cost because waste types are probably mixed and the location of sludges or drummed liquids is not known. There is no operation and maintenance associated with excavation. Excavation was carried forward for further consideration.

d. Disposal

The disposal response action involves placing and permanently storing excavated material in an off-site or on-site RCRA-approved disposal

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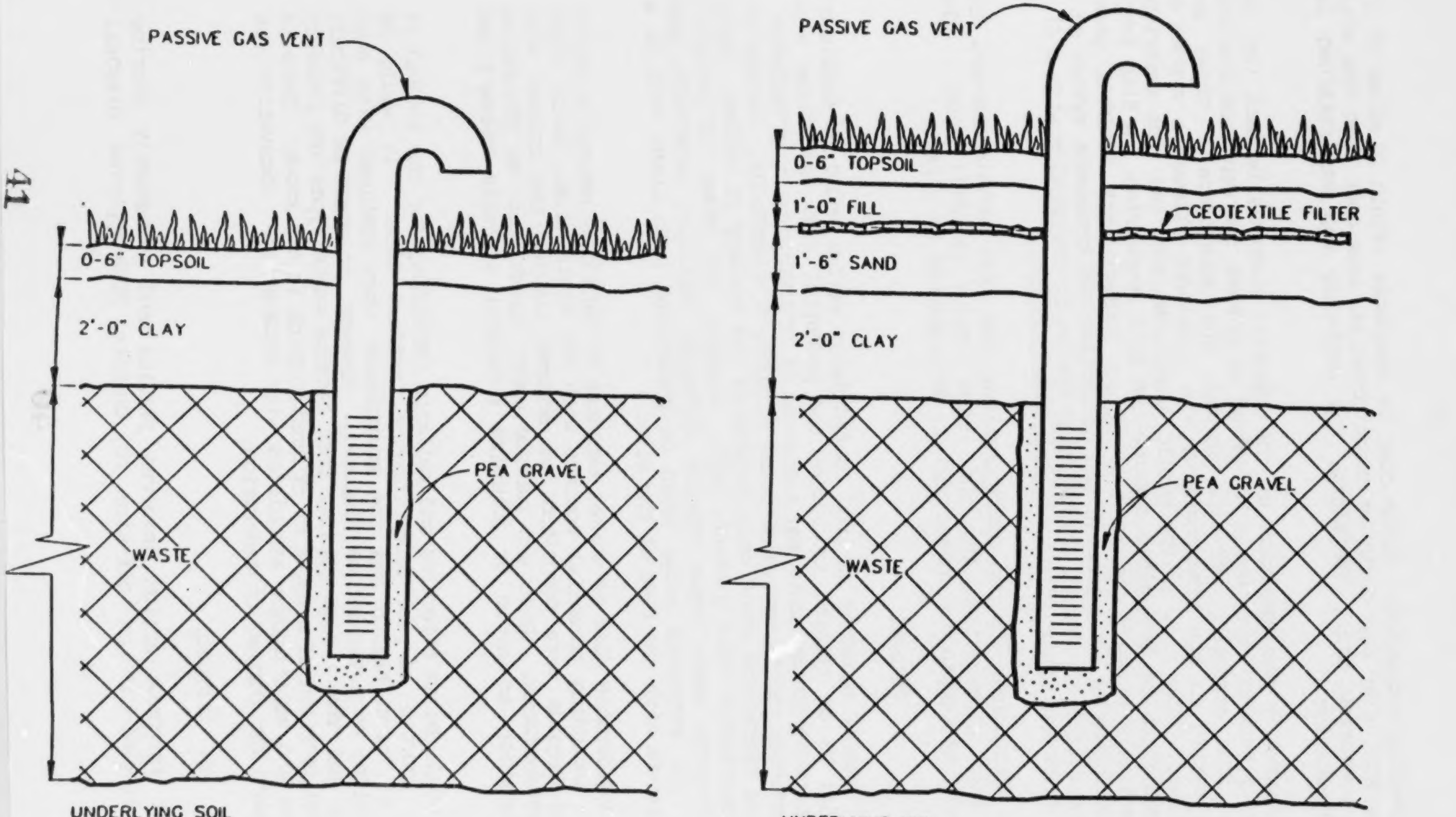

PASSIVE GAS VENT
0-6" TOPSOIL
2'-0" CLAY
PEA GRAVEL
WASTE
UNDERLYING SOIL
PASSIVE GAS VENT
0-6" TOPSOIL
1'-0" FILL
GEOTEXTILE FILTER
1'-6" SAND
2'-0" CLAY
PEA GRAVEL
WASTE
UNDERLYING SOIL

REGRADE AND REVEGETATE
(Single-Layer Cap)

SOIL-CLAY CAP

NOT TO SCALE

FIGURE 14
CAP OPTIONS

facility. A RCRA facility is controlled, monitored, and regulated to minimize the potential for uncontrolled releases of contaminants. Disposal in a RCRA landfill is an effective and reliable means of controlling the migration of and exposure to contaminants. Since RCRA prohibits the direct landfilling of containerized and bulk liquids, they would be separated from the solid materials and treated before disposal.

The landfill contents could be transported to an off-site RCRA-approved facility. Two interim status RCRA landfills near the Mason County Landfill have reserve capacity. One is about 250 miles from the Site in Detroit, Michigan and the other is approximately 500 miles from the Site in Cincinnati, Ohio.

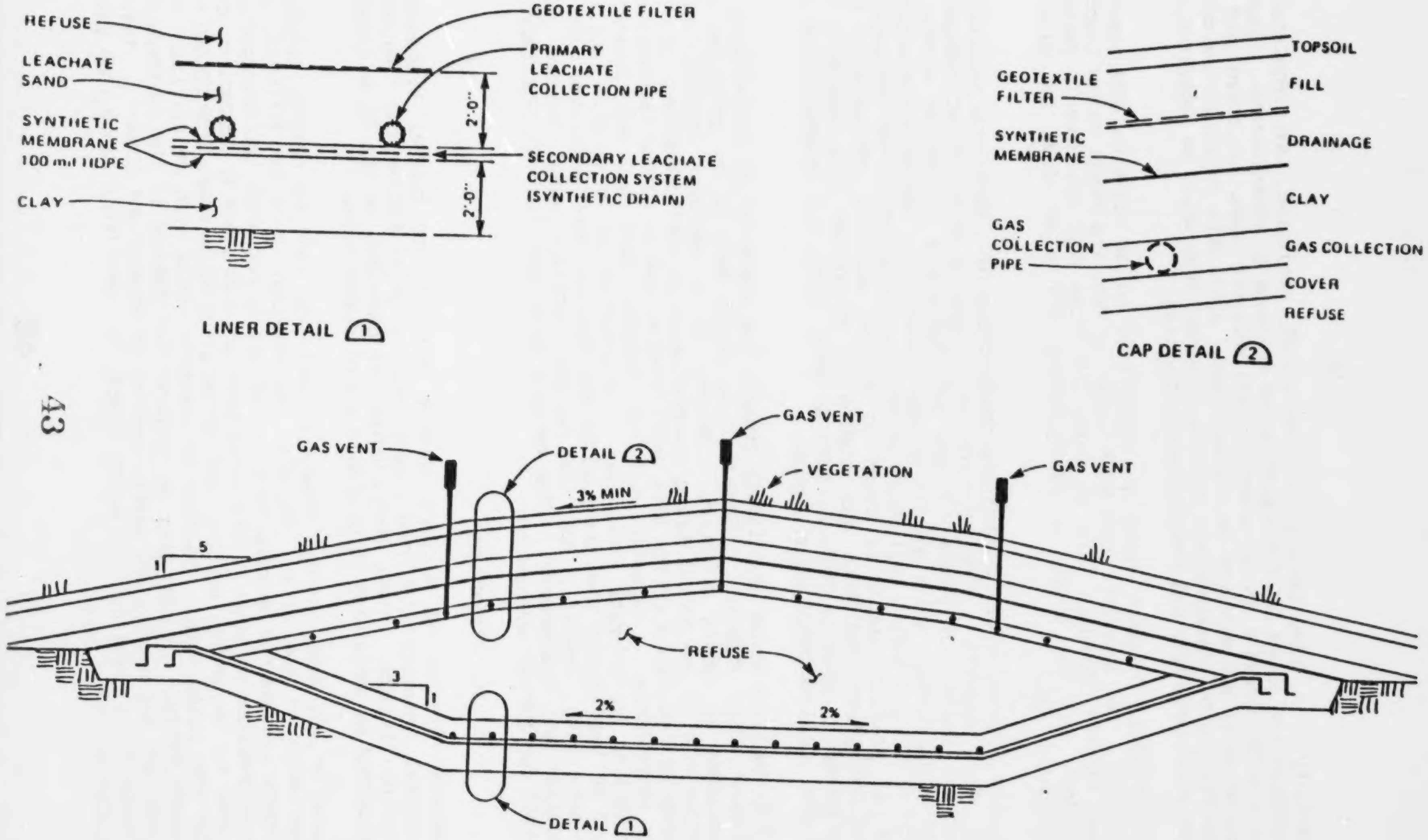
On-site disposal would involve the construction of a RCRA-type facility on the site property. The facility would have a double-lined bottom, a leachate collection system, a gas and condensate collection system, a monitoring system, and a multilayer cap (Figure 15). Buried waste would be removed and a landfill cell would be constructed before it was redeposited. Special measures would be taken to prevent airborne contaminants from reaching nearby residents and erosion of stockpiles from degrading the environment. Erosion controls such as spray foams and temporary dams and ditches could minimize these threats.

A RCRA facility would effectively control the migration of contaminants to drinking water supplies. The facility would have to be monitored and maintained to remain effective. Removal to an off-site location would involve risk to the public during transportation on public highways, and the stockpiling of wastes on the Site would involve risk to nearby residents and the environment. Capacity and the federal land ban are potential limitations on off-site facilities. Construction of an on-site facility would be less costly than the hauling and disposal fees associated with an off-site RCRA landfill, but the on-site facility would require some operation and maintenance. The on-site RCRA-type landfill was carried forward for further evaluation.

e. Treatment

Treatment alternatives include on-site and off-site thermal treatment, biological treatment involving composting, and physical/chemical treatment involving fixation. These technologies are described in the FS and their evaluations as pertaining to this Site are discussed below.

On-site or off-site thermal treatment could be used to destroy organic contaminants at the Site. Off-site incineration would be difficult to implement because the material must be processed, packaged, and transported several hundreds of miles. This could take up to 20 years to accomplish and the cost for packaging, hauling, and incinerating could range from $2,000 to $5,000 per cubic yard. On-site incineration would also be difficult to implement because material must be prepared for feeding to the incinerator and then ash and particulate matter need to be handled and disposed. There is little field experience to verify costs, but they could range from $500 to $1,000 per cubic yard.


REFUSE
LEACHATE SAND
SYNTHETIC MEMBRANE 100 mil HDPE
CLAY
GEOTEXTILE FILTER
PRIMARY LEACHATE COLLECTION PIPE
2'-0"
SECONDARY LEACHATE COLLECTION SYSTEM (SYNTHETIC DRAIN)
2'-0"
GEOTEXTILE FILTER
SYNTHETIC MEMBRANE
GAS COLLECTION PIPE
TOPSOIL
FILL
DRAINAGE
CLAY
GAS COLLECTION
COVER
REFUSE
GAS VENT
DETAIL 2
GAS VENT
VEGETATION
GAS VENT
3% MIN
1
5
REFUSE
3
1
2%
2%
DETAIL 1

LINER DETAIL ①

CAP DETAIL ②

TYPICAL LANDFILL SECTION
NOT TO SCALE

FIGURE 15
ONSITE RCRA-TYPE

Both off-site and on-site thermal treatments are cost prohibitive compared to biological or physical/chemical treatment, so they were not carried forward for further evaluation.

Composting could reduce the level of organic contamination; however, the effectiveness of composting with respect to the degradation of volatile organics is not well known and it could take years for contaminant levels to decrease sufficiently. During that time, landfill contents would remain uncovered in windrows at the Site. Composting would not degrade heavy metals, and certain toxic heavy metals could inhibit the biological growth necessary for the degradation process. Thus, composting would not effectively treat the variety of materials expected to be present in the landfill, and the implementation time could not be predicted. For these reasons, composting was not carried forward for further evaluation.

Fixation could immobilize Site contaminants. Implementation would be difficult because excavated wastes must be segregated into discrete types based on physical properties (i.e., material type and size) and reduced to manageable sizes for mixing. A variety of fixing agents and formulas would probably be needed to treat the expected variety of materials. Other types of treatment might be applicable for the landfill contents but cannot be selected at this time because of unknowns involving the types and quantities of buried materials on-site. Fixation was carried forward as the representative treatment option for the landfill contents.

2. Groundwater Operable Unit

The technologies and process options evaluated for the groundwater operable unit and corresponding evaluation summaries are as follows:

a. Access Restrictions and Monitoring

The objectives and effectiveness of access restrictions are discussed under "Landfill Contents Operable Unit." Legal restrictions would be imposed to prohibit the use of groundwater as a drinking water supply in areas downgradient of the landfill affected by the contamination plume. Monitoring of groundwater downgradient of the landfill would detect increases in contaminant concentrations and the spread of the contamination plume. If established target levels were exceeded, additional remedial actions could be taken. Groundwater monitoring would be accomplished by a regular sampling and analysis program of the existing well network. New wells could be installed to provide data in areas between wells that are spaced far apart. Monitoring would verify the protection of human health and the environment and could be easily implemented at low cost.

Legal restrictions and groundwater monitoring are effective methods of protecting human health, easy to implement, and low in cost. Because they are significantly different, both were carried forward for assembly into alternatives.

b. Collection

The applicable collection technology for the Mason County Landfill Site would be an extraction well system. The collection, disposal and treatment of contaminated groundwater would prevent contaminants in the groundwater from migrating from the Site. The system would consist of a series of wells, located downgradient of the landfill, that will intercept the groundwater contamination plume. Contaminated groundwater is pumped to the surface and routed by a gravity or pressurized pipeline to a treatment or disposal system. The number of wells, well locations and groundwater extraction rates would be determined during the design stage to ensure effective and efficient control of the contamination plume.

An extraction well system has moderate capital and operation and maintenance costs and, properly designed and constructed, would be effective, reliable, and durable. Mechanical breakdowns during operation of the system should be routine. Therefore, extraction wells were carried forward for further consideration.

c. Treatment

Treatment alternatives include off-site treatment including the use of a RCRA facility or a publicly owned treatment works (POTW) and on-site treatment including physical/chemical treatment such as reverse osmosis, ion exchange, precipitation, air stripping, steam stripping and carbon adsorption. These technologies are described in the FS and their evaluations as pertaining to this Site are discussed below.

Off-site treatment would require transporting large volumes of groundwater to a RCRA facility or POTW. The POTW is within 3 miles of the Site, so transportation to the POTW would be less costly. However, treatment volumes for either alternative could range as high as 500,000 gpd which would require hauling of 50 truckloads of groundwater per day and a one million gallon tank to provide two day storage. Because of the high volume of water that would need to be stored and hauled, off-site treatment was not carried forward.

None of the individual on-site treatment technologies would completely remove both the organic and inorganic constituents in the groundwater, however, two technologies could be implemented together. Reverse osmosis and ion exchange units were eliminated from consideration because of their higher costs relative to other options. Neither air nor steam stripping can remove inorganic constituents, whereas granular activated carbon adsorption (GAC) can remove some of the inorganic constituents. Thus, the GAC process is more versatile and would require less pretreatment of contaminated groundwater. Since the GAC process requires less pretreatment and is less costly to operate than air and steam stripping because of lower energy demands, the GAC process was retained for further consideration.

The treatment system that appears to be most suitable for the Site would consist of precipitation and carbon adsorption, although other systems would probably work and may be determined more suitable in final design.

Precipitation would be used as pretreatment to remove some inorganic constituents in the groundwater. The low contaminant load in the groundwater will require high chemical dosages to precipitate the inorganic constituents, which will generate high volumes of sludge. The sludge is excepted to contain high enough concentrations of certain toxic heavy metals that it would have to be handled and disposed of as a hazardous waste. Therefore, the treatment system should be designed to minimize sludge production.

Implementation of the treatment system would require a pilot study to develop the most efficient balance for contaminant removal rates by precipitation unit and the GAC column. Installation of the system would be easy because skid-mounted treatment units are available. An on-site operator should be present to monitor for contaminant breakthrough and replacement of carbon beds.

B. Alternatives Considered

Remedial alternatives considered for this Site are combinations of actions and technologies that represent overall approaches to the Site problems and remedial goals. The six technologies that remained after screening range from simple, low cost alternatives to alternatives more costly and complex and address the remedial goals identified in Section VII A of this ROD and within the FS. The alternatives that underwent detailed evaluation are listed below along with a detailed description of each.

Alternative 1 - No Action

Alternative 1 is the no action alternative, which the National Contingencies Plan (NCP) requires for baseline comparison to other alternatives. Under the no action alternative, no further remedial investigation or action would be conducted, and the public health and environmental risks would be those identified in the risk assessment.

The pathway of most concern is the potential contamination of residential wells downgradient of the Site. Those wells are not currently contaminated and do not pose an immediate public health risk, but the potential for release of contaminants from uncontrolled hazardous substances in the landfill may pose a future threat. Lower public health and environmental risks are associated with migration of contaminated groundwater to Babbin Pond and Iris Creek. Direct contact with buried waste and ingestion of contaminated groundwater could occur if future residential development were allowed on-site.

Alternative 2 - Site Restrictions

Alternative 2 consists of Site access restrictions and a monitoring program (Figure 16). It would reduce the public health risks by controlling access to on-site contaminants and by monitoring contaminant migration in groundwater.

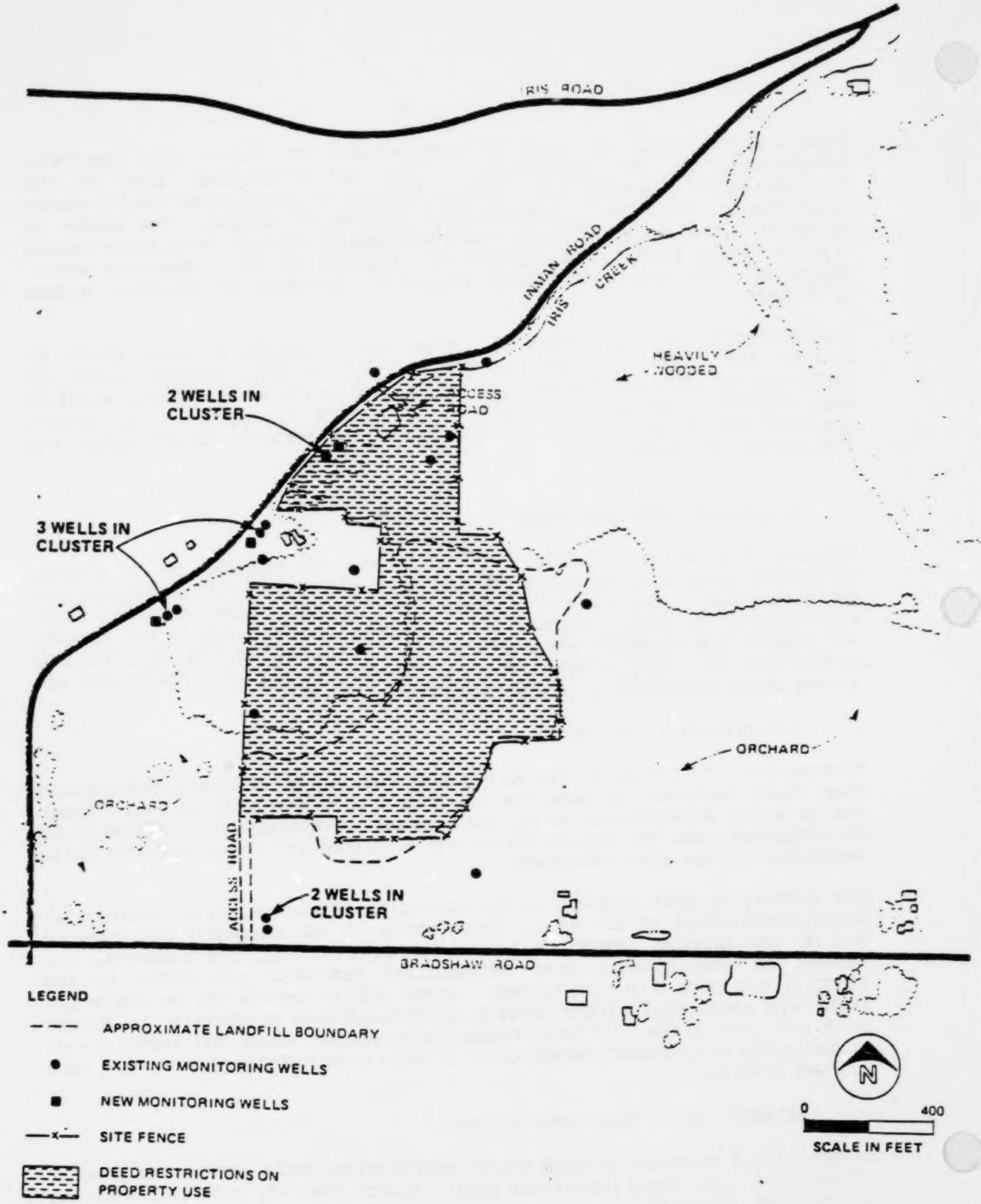

IRIS ROAD
INMAN ROAD
IRIS CREEK
HEAVILY WOODED
ACCESS ROAD
2 WELLS IN CLUSTER
3 WELLS IN CLUSTER
ORCHARD
ORCHARD
ACCESS ROAD
2 WELLS IN CLUSTER
BRADSHAW ROAD
LEGEND
APPROXIMATE LANDFILL BOUNDARY
EXISTING MONITORING WELLS
NEW MONITORING WELLS
SITE FENCE
DEED RESTRICTIONS ON PROPERTY USE
N
0
400
SCALE IN FEET

FIGURE 16
ALTERNATIVE 2
SITE RESTRICTIONS
MASON COUNTY LANDFILL FS

Access restrictions would consist of a Site fence, warning signs, and deed and zoning restrictions on property use. A six foot high fence 4,800 feet long, with locking gates, would be installed on or near the property boundary. Alternatives to the site fence will be considered if they are determined to adequately protect the landfill cap integrity and keep trespassers away from the area of the gas vents. Signs would be posted to warn intruders of the health hazard. Deed restrictions would prohibit future Site development and the installation of water supply wells on the Site.

The monitoring program would consist of periodic sampling and analysis of 20 monitoring wells. Four new monitoring wells would be installed along Inman Road to provide additional information about the vertical and horizontal migration of contaminants. Groundwater would be analyzed annually for Target Compound List volatile organic compounds and semiannually for typical landfill monitoring parameters such as pH, specific conductivity, total dissolved solids, total organic carbon, total organic halide, iron, chloride, nitrate, and sulfate.

Performance and Reliability - Alternative 2 does not have processes or equipment that might fail and the reliability of its components has been demonstrated. It would prevent direct public contact with buried waste, landfill gases and contaminated sediment and surface soil. In addition, it would track and document the nature and extent of contaminant migration.

Changes in deed restrictions would be unlikely because the property is owned by the Mason County DPW. Groundwater use restrictions on privately owned property downgradient of the landfill would be difficult to enforce. Currently such restrictions are not needed as no residential wells are contaminated at this time; groundwater monitoring would provide warning if contaminant levels increased in the future. Monitoring requires semi-annual visits to the Site to collect samples and continued sample management efforts to document water quality. Future actions could be implemented as appropriate.

The Site fence and warning signs would prevent human contact with gas vent emissions and contaminated surface soils or sediments. They would also help protect the integrity of the landfill cap by limiting vehicle access. The fence would require routine maintenance for a prolonged useful life.

Implementation - Alternative 2 could be readily implemented. The four new monitoring wells and Site fence could be easily installed by local contractors. Construction of the Site fence would require some clearing of trees and shrubs, and a survey would be needed to define the property boundaries. It appears that some of the landfill is outside the property boundary.

Alternative 2 would not pose unusual or high levels of risk to workers or the public during implementation. Installation of the fence should not disturb any buried wastes and the wells would be installed in areas of low contaminant levels. Sampling team members for the monitoring program could be exposed to volatile organic compounds for the life of the action, so well construction and sampling work should proceed under Level D health and safety protection. Air monitoring during sampling activities would ensure that exposure limits are not exceeded.

- Alternative 3 - Containment (Surface Controls)

Alternative 3 consists of surface control measures as well as the Site restrictions associated with Alternative 2 (Figure 17). It would reduce public health and environmental risks by restricting Site access, by monitoring contaminant migration in groundwater, and by reducing the leachate volume and associated groundwater contamination.

Surface controls would consist of clearing vegetation and regrading the Site. Approximately 18,000 cubic yards of imported clay would be needed to fill Site depressions, such as the ponded area, to increase the cap thickness to at least 2 feet and to establish a three to five percent grade. Approximately 9,000 cubic yards of imported soil would be needed for a six inch thick layer of topsoil to support vegetation. The existing drainage structures (berms, area drains, and buried pipelines) would be incorporated into the final grading plan and upgraded as necessary. Erosion control mats would be placed on the steep side slopes north of the landfill to help establish vegetation, and erosion gullies would be filled and reseeded.

Performance and Reliability - The components of Alternative 3 are demonstrated and reliable. Surface controls would reduce the amount of water percolating through the landfill contents by eliminating cracks and ponded areas, increasing the minimum surface slope to five percent, increasing the soil moisture storage capacity, and increasing the evapotranspiration rate. Based on water balance calculations (Appendix A of the FS), the percolation rate and, thus, the volume of generated leachate would be reduced about fifty percent.

Periodic inspection and maintenance of the landfill cap is necessary for continued effectiveness at reducing water infiltration. Moderate to high settlements are expected at the Site, considering the nature of the landfill contents (mainly municipal garbage and trash) and settlements that have already occurred. Maintenance would consist of refilling and reseeding areas of subsidence and erosion. Replacement of the cap should not be necessary if proper maintenance procedures are employed throughout the life of the remedial action.

Implementation - Alternative 3 could be implemented using routine construction methods and equipment. Top soil, clay, and sand are available within ten miles of the Site, and other necessary materials are commonly available. A topographical survey would be needed to design a Site grading plan. The 15 gas vents would probably be destroyed and have to be replaced. Incorporating all existing drainage structures may be difficult, so some area drains and buried pipeline may be needed.

Workers on the Site during regrading and gas vent replacement may be exposed to buried wastes. Regrading is not intended to disturb the underlying landfill contents; Level D protection (minimum worker protective clothing)

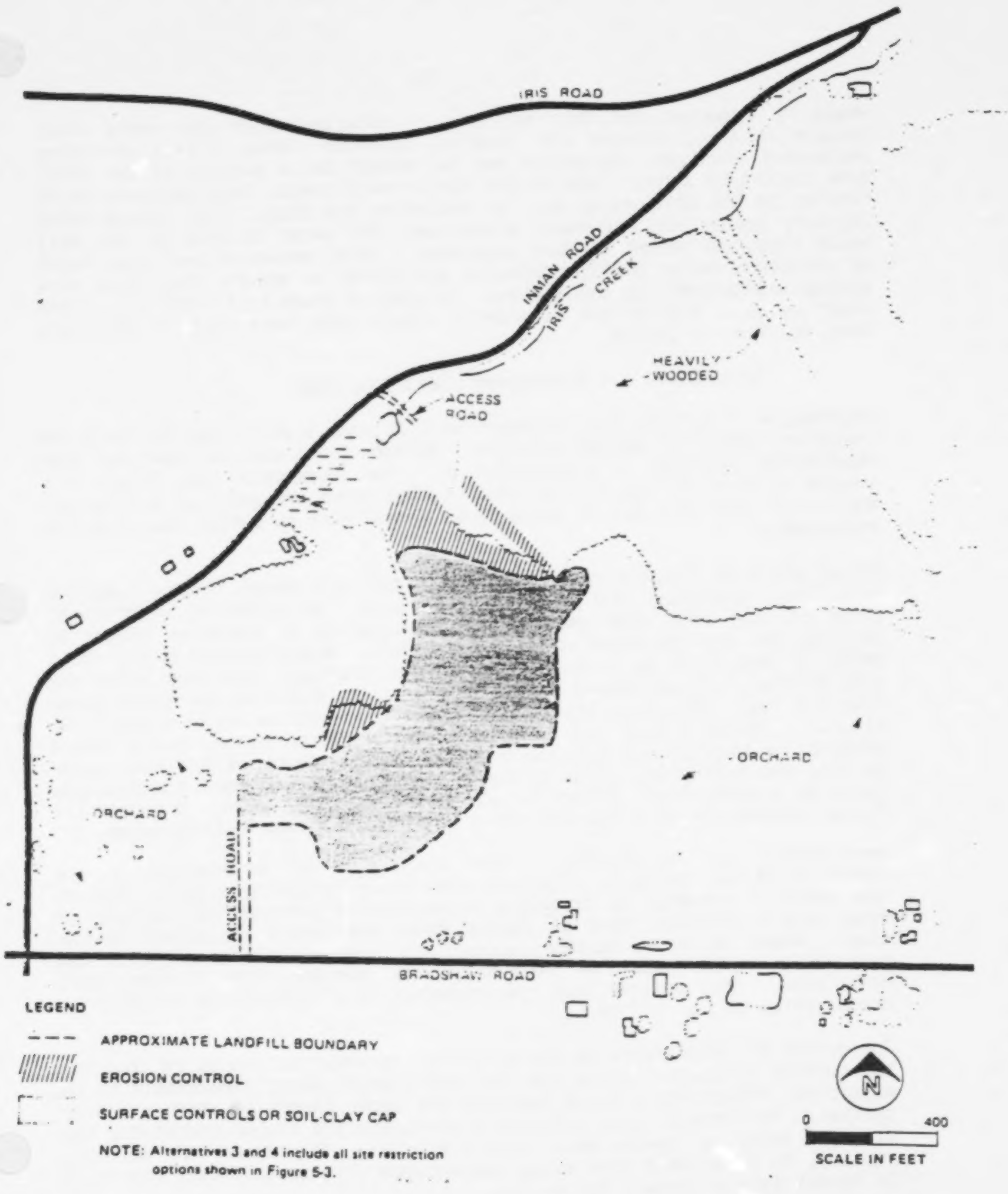

IRIS ROAD
INMAN ROAD
IRIS CREEK
HEAVILY WOODED
ACCESS ROAD
ORCHARD
ORCHARD
ACCESS ROAD
BRADSHAW ROAD
LEGEND
APPROXIMATE LANDFILL BOUNDARY
EROSION CONTROL
SURFACE CONTROLS OR SOIL-CLAY CAP
NOTE: Alternatives 3 and 4 include all site restriction options shown in Figure 5-3.
N
0
400
SCALE IN FEET

FIGURE 17
ALTERNATIVES 3 AND 4 --
CONTAINMENT
MASON COUNTY LANDFILL FS

would be expected for this activity. Installation of gas vents would require drilling through the landfill contents; Level C (air purifying respirator required) protection may be needed for a portion of the work. Some short-term safety risks to the public would result from increased truck traffic in the area while soil is hauled to the Site. Dust levels could increase during the earthwork activities, but water sprayed on dry soil would limit the amount of dust generated. Total suspended particles would be monitored daily during earthwork activities to ensure compliance with appropriate ambient air regulations. Erosion of loose soil along Iris Creek could be prevented by use of plastic covers over bare soil or temporary dams, ditches, or fences.

Alternative 4 - Containment (Soil-Clay Cap)

Alternative 4 differs from Alternative 3 in that a soil-clay cap would be installed instead of surface controls. Alternative 4 also includes the Site restriction measures of Alternative 2. The components (see Figure 17) consist of property use restrictions, a Site fence, groundwater monitoring, and a soil-clay cap, all of which would reduce risk to public health or the environment.

Installation of the soil-clay cap (see Figure 14) would involve removing vegetation, regrading, and placing a clay layer. An estimated 18,000 cubic yards of clay (the same quantity for Alternative 3) would be needed to increase the cap thickness to at least 2 feet. Approximately 28,000 cubic yards of sand would be needed for an 18-inch drainage layer just above the clay barrier, and perforated drain pipes would be installed to remove water from the cap. The drain pipes would route the water to storm drains that discharge downhill from the landfill. The existing stream drains could possibly be incorporated into the drainage system. About 19,000 cubic yards of fill and 9,300 cubic yards of topsoil would be placed above the drainage layer to provide frost protection and soil moisture storage. A geotextile filter between the fill and sand would prevent the drains from clogging.

Performance and Reliability - The components of Alternative 4 are demonstrated and reliable. The soil-clay would reduce percolation through the landfill contents by providing a barrier to prevent infiltration of water and a drainage layer to remove water that might accumulate on the clay. Based on water balance calculations (Appendix A in the FS), the percolation rate would be reduced ninety percent from current Site conditions. This assumes that the compacted clay barrier has a hydraulic conductivity of 1×10^{-7} cm/s.

Inspection and maintenance of the soil-clay cap would be similar to that for the surface controls. Since the cap must remain nearly impermeable to be effective, repair may involve removing the upper layers to reach the clay barrier. Settlements could eventually eliminate the slopes needed for the drainage layer to remove water from the clay. To account for periodic repairs, it is assumed that annual maintenance for the soil-clay cap would be needed for the 30-year design life.

Implementation - Alternative 4 would be more difficult and take more time to implement than Alternative 3. Additional attention to details during design and construction would be required for the individual components of the soil-clay clap to function properly. Potential problems include leakage of water through the clay barrier at gas vent locations, surface infiltration collection details, and construction on the steep side slopes. Also, a potential problem would be the continued subsidence of the landfill and its effects on drainage systems, such as perforated pipes. Protection of workers and nearby residents during construction would be similar to that for Alternative 3.

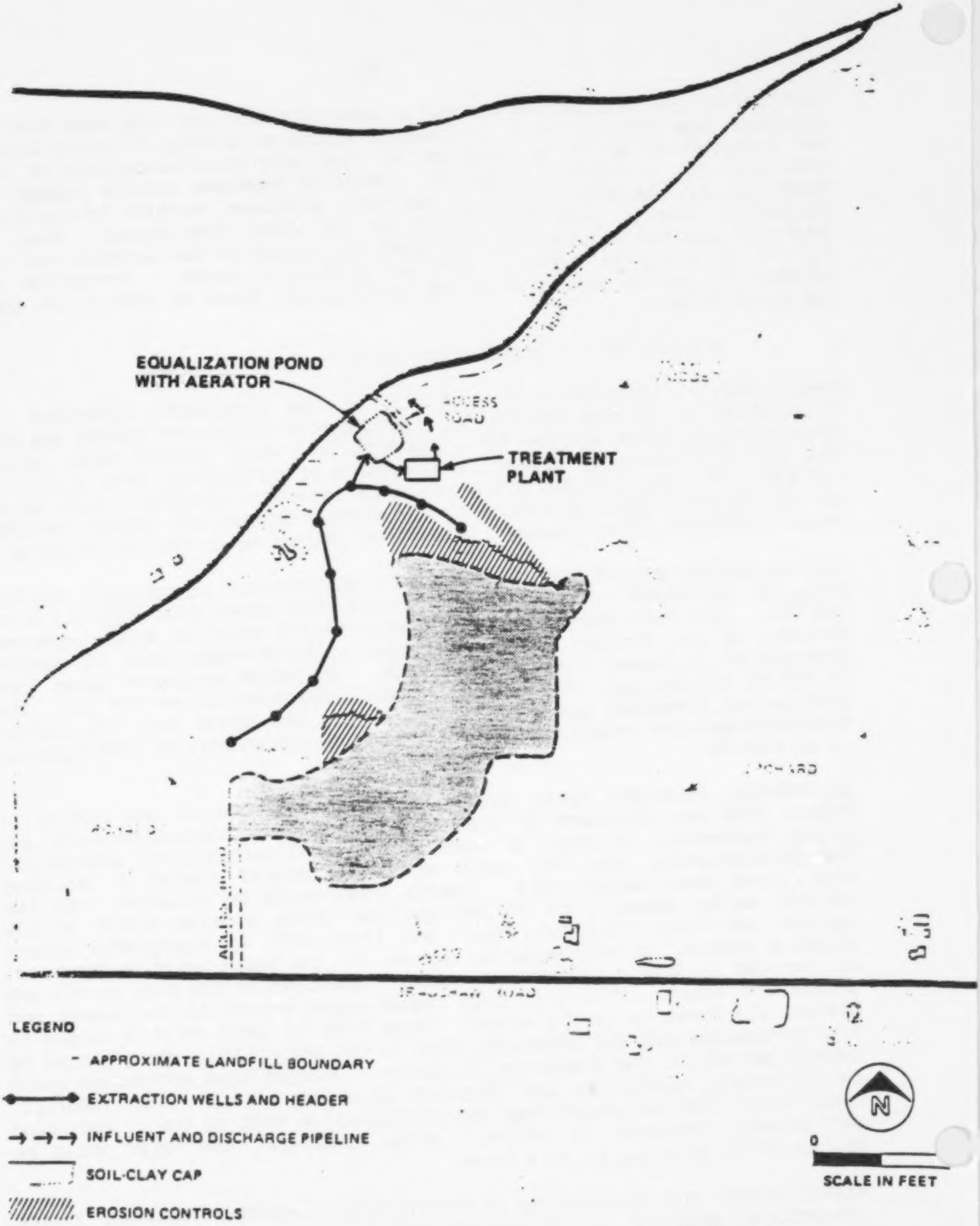
Alternative 5 - Groundwater Collection and Treatment

Description - Alternative 5 consists of the components described in Alternative 4 with the addition of a groundwater collection system and on-site treatment plant (Figure 18). Alternative 5 would protect human health and the environment by preventing contaminated groundwater from migrating off the Site. Contaminant levels in the groundwater contaminant plume north of the landfill would be reduced below maximum contaminant levels, and the water discharged after treatment would meet ambient water quality criteria.

Ten extraction wells spaced 200 feet apart and screened in the upper aquifer would be sufficient to intercept the contaminant plume (see Appendix B of the FS). Each well would have a discharge control valve to ensure adequate drawdown of the aquifer. A buried header pipeline would route the pumped groundwater to Babbin Pond for discharge. Discharge estimates range from 35,000 to 500,000 gpd; the average estimated discharge is 160,000 gpd. The groundwater treatment system described herein was based upon the average discharge and flow weighted maximum contaminant concentrations (see Appendix C of the FS).

Groundwater treatment would consist of flow equalization and mixing in Babbin Pond and treatment by precipitation (with associated settling and sludge dewatering) followed by granular activated carbon (GAC) adsorption. The precipitation and GAC units would be housed inside a building constructed near Babbin Pond. Babbin Pond would be enlarged from its 220,000 gallon capacity to 320,000 gallons (2-day storage volume at the average estimated collection rate) and lined with an impermeable double membrane system. A leak detection system for the basin would be installed as required by RCRA. An aerator would be installed in the pond to mix and aerate the water. This will help reduce algae growth in the summer and prevent ice formation in the winter. Water from the pond would be pumped to a precipitation unit for treatment prior to GAC adsorption. The pH would be controlled within the precipitation system. Sludges that accumulate would be collected, solidified, and disposed of at an off-site RCRA landfill. Water would then be pumped from the precipitation unit to two 10,000 pound GAC columns connected in series. After treatment, the water would be discharged by pipeline to Iris Creek.

Effectiveness and Reliability - Alternative 5 would effectively reduce contaminant mobility by collection and treatment of the groundwater. Toxicity would not be reduced because hazardous materials would be


EQUALIZATION POND WITH AERATOR
ACCESS ROAD
TREATMENT PLANT
ORCHARD
LEGEND
APPROXIMATE LANDFILL BOUNDARY
EXTRACTION WELLS AND HEADER
INFLUENT AND DISCHARGE PIPELINE
SOIL-CLAY CAP
EROSION CONTROLS
N
0
SCALE IN FEET

NOTE: Alternative 5 includes all site restriction options shown in Figure 5-3.

FIGURE 18
ALTERNATIVE 5
GROUNDWATER COLLECTION
AND TREATMENT
MASON COUNTY LANDFILL FS

concentrated in sludges and spent carbon. However, risks at the Site caused by contaminants in the groundwater would be reduced because the residuals would be hauled to a RCRA facility.

The collection and treatment system has demonstrated reliable performance. The pumping system would require routine inspections, but maintenance would be routine. Pumps would require servicing every few years, and the treatment plant would require a full-time operator (8 hours per day). Many of the components would require eventual replacement (e.g., storage tanks and pumps), and activated carbon, alum, anionic polymer, and soda ash would have to be purchased periodically.

The discharged water and the contaminant plume would be monitored throughout the life of the action to measure compliance with state and federal regulations. Discharge parameters would include continuous monitoring for dissolved oxygen and pH and bimonthly analysis for hazardous substances as required by the NPDES permit.

Implementation - Alternative 5 could be implemented with difficulty associated with both collection and treatment. Groundwater collection would be complicated by the hydrogeology at the Site and poor access to well locations. Part of the well alignment would go outside the property lines, and additional property would need to be purchased or permission granted by the property owner for installation. Pumping could adversely affect nearby residential wells; however, the effect should be minimal because the residential wells are either greater than 400 feet from the extraction wells or are screened in the lower aquifer.

Babbin Pond would need a double liner with a leak detection system. The area would have to be dewatered during construction of the liner and the water hauled off-site for treatment. The dewatering system would be left in place in case of emergency repair to the liner. Pump tests would be performed for each well installation to determine the actual cones of depression and, thus, adequate well spacing. Water generated from the pump tests would also need to be contained and hauled off-site for treatment.

After the extraction and collection system is installed, the actual contaminant loadings to the treatment system will be determined; pilot testing would determine the necessary treatment plant components, holding times, and rates of chemical addition. The groundwater contaminant plume might be diluted during extraction, but it was conservatively assumed that the maximum detected contaminant levels could be collected and the treatment system was sized accordingly for this study. The components of the treatment system could be purchased complete from various vendors. Several mechanical parts would require routine maintenance, and the treatment process must be carefully monitored to prevent breakthrough. An automatic alarm system would be installed for after-hour plant emergencies. The plant would produce about 640 gallons of sludge at thirty percent solids per day. The sludge would require periodic transport and disposal at a RCRA facility.

Health and safety risks during implementation would include potential direct contact with contaminated water during well installation and dewatering activities associated with installation of the pond liner. However, contaminant levels are low and Level D protection is expected to be adequate. There are some health risks associated with sludge handling and carbon regeneration, and trained personnel would be required. Risks to the public would consist of transport of contaminated water and sludge on public highways.

Alternative 6 - Removal, Treatment, and Disposal

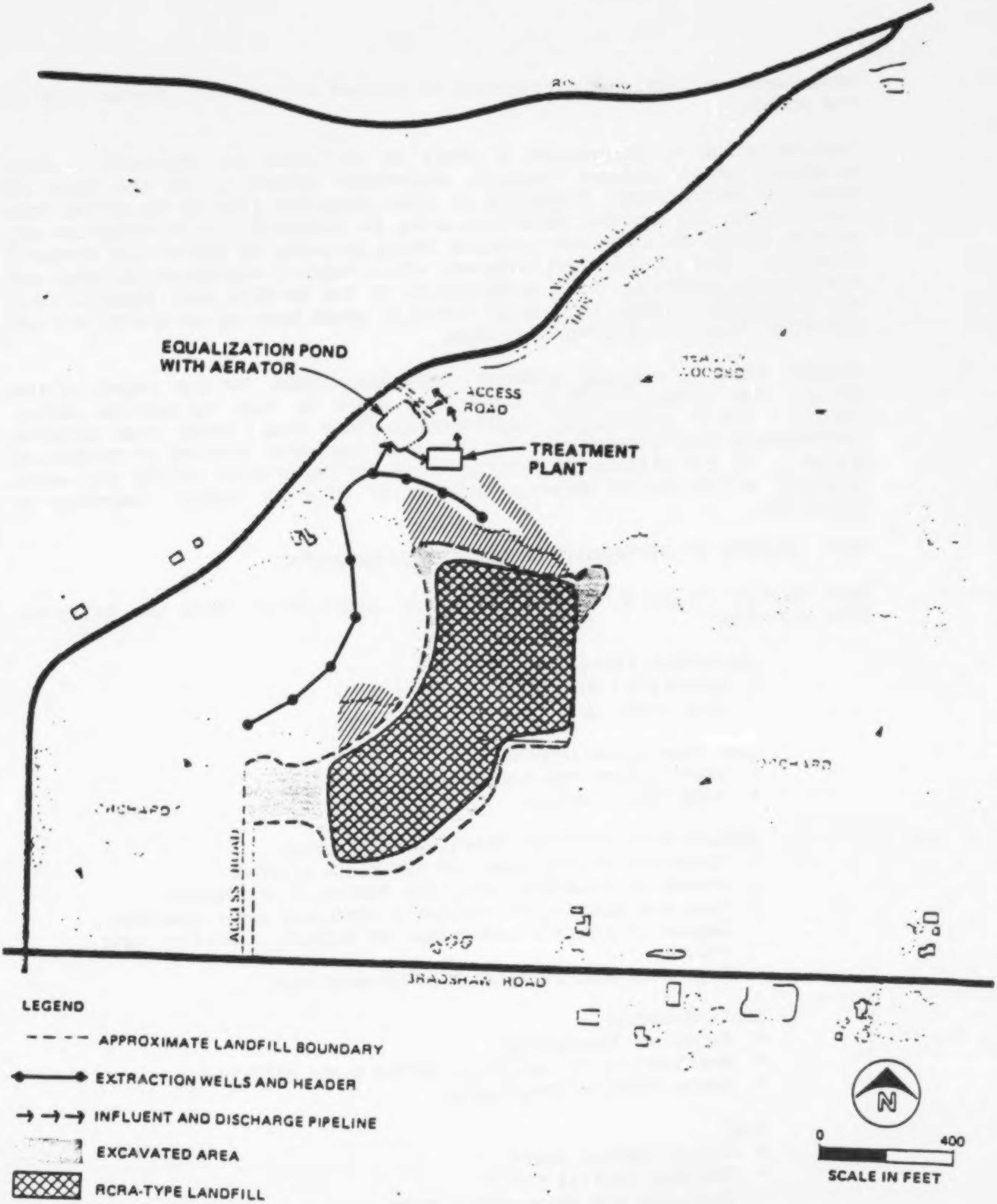
Alternative 6 consists of the components of Alternative 5 with the addition of the removal and treatment of landfill contents (Figure 19). Only removal, treatment, and disposal of landfill contents is described below. A RCRA-type landfill facility would be constructed on-site to contain the landfill contents. Alternative 6 would reduce the mobility of contaminants through treatment (fixation) and contaminant.

An estimated 140,000 cubic yards of material would be excavated and segregated for treatment. Materials would be sorted according to waste type (i.e., metal, paper, plastics) and size. Preprocessing would consist of shredding or breaking the materials to sizes that could readily be mixed with the appropriate fixing agents. All excavated material would be temporarily stockpiled during preprocessing in a specially constructed building with a leachate collection system. Waste materials and fixing agents could be mixed in a pit or directly in the newly constructed RCRA facility using equipment such as front-end loaders, bulldozers, and backhoes.

It is difficult to estimate accurately the size of the on-site RCRA-type facility necessary to store hazardous materials because of inaccuracies associated with the landfill volume estimate, the increase in volume caused by the addition of fixing agents, and the final depth of fill in the new facility. Based on the estimated 140,000 cubic yards of material and an assumed volume increase of ten percent, the RCRA-type facility would need to contain a volume of roughly 150,000 cubic yards. Assuming that wastes could be placed to an average thickness of twelve feet, an area of about eight acres would be needed. Quantities of earthwork and other materials needed to construct the RCRA-type facility are based on the cross-sectional dimensions shown in Figure 15.

Effectiveness and Reliability - Alternative 6 would effectively reduce contaminant mobility at the Site, but would not reduce the toxicity and volume of contaminants. Groundwater monitoring would be necessary to ensure that contaminants do not leak through the liner of the landfill. The effectiveness of the facility would depend upon continued maintenance of the cap and upon collection, treatment, and disposal of leachate.

By controlling the contaminant source, contaminant loading of the groundwater would be virtually eliminated. At some future time contaminant levels in the groundwater contaminant plume are expected to be reduced below levels that would cause public health or environmental risks. Since it is not possible to predict the time period necessary for this to occur,


EQUALIZATION POND WITH AERATOR
ACCESS ROAD
TREATMENT PLANT
HEAVILY WOODED
ORCHARD
ORCHARD
ACCESS ROAD
BRADSHAW ROAD
LEGEND
APPROXIMATE LANDFILL BOUNDARY
EXTRACTION WELLS AND HEADER
INFLUENT AND DISCHARGE PIPELINE
EXCAVATED AREA
RCRA-TYPE LANDFILL
N
0
400
SCALE IN FEET

NOTE: Excavation limits are the approximate landfill boundary. Alternative 6 includes all site restriction options shown in Figure 5-3.

FIGURE 19
ALTERNATIVE 6
REMOVAL, TREATMENT, AND DISPOSAL
MASON COUNTY LANDFILL FS

groundwater collection and treatment is assumed for the full 30-year life of the action.

Implementation - Alternative 6 would be difficult to implement. Work schedules would require constant adjustment depending on the type of materials encountered. Hazardous or toxic materials have to be sorted from nonhazardous and nontoxic materials prior to treatment. Size reduction and several different treatment mixtures would probably be needed for adequate fixation. The construction sequence would require excavating an area and stockpiling materials until construction of the on-site RCRA landfill cell was completed. Large volumes of material would have to be stockpiled and protected from wind and water erosion.

Workers would be exposed to health and safety risks for the length of the action, but Levels B and C protection would be used to protect worker health. Public health and environmental risks could occur from airborne contaminants during excavation or from wind and water erosion of stockpiled wastes. An air monitoring program would be implemented during any waste handling activities to detect emissions of volatile organic compounds or particles.

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

This section compares the six remaining alternatives using the following nine criteria:

Short-Term Effectiveness
* Protection during remedial actions.
* Time until protection is achieved.

Long-Term Effectiveness
* Magnitude of residual risk.
* Long-term controls.

Reduction of Toxicity, Mobility, and Volume
* Treatment process used and materials treated.
* Amount of hazardous materials destroyed or treated.
* Type and quantity of residuals remaining after treatment.
* Degree of expected reductions in toxicity, mobility, and volume.
* Degree to which treatment is irreversible.

Implementation
* Technical feasibility.
* Availability of necessary services and materials.
* Administrative feasibility.

Cost
* Direct capital costs.
* Indirect capital costs.
* Operation and maintenance costs.
* Total present worth.

Compliance with ARARs
* Compliance with contaminant-specific ARARs.
* Compliance with action-specific ARARs.
* Compliance with location-specific ARARs.

Overall Protection
* How alternative provides protection of human health and the environment.

State Acceptance
* Aspects of the alternative that the state supports.
* Aspects of the alternative about which the state has reservations.
* Aspects of the alternative that the state strongly opposes.

Community Acceptance
* Aspects of the alternative that the community supports.
* Aspects of the alternative about which the community has reservations.
* Aspects of the alternative that the community strongly opposes.

Seven of the nine evaluation criteria (excluding state acceptance and community acceptance) are summarized in Table 6. State acceptance and community acceptance are discussed later in this ROD. Specific ARARs that apply or may apply to each alternative are listed in Table 7.

Costs for each alternative are detailed within the FS report and are summarized in Table 8.

IX. PROPOSED PLAN AND DOCUMENTATION OF SIGNIFICANT CHANGES [SECTION 117(b)]

The U.S. EPA's Proposed Plan was released for public comment from August 8 through August 31, 1988. In the Proposed Plan, the U.S. EPA stated that the remedial action at this Site will be divided into two separate operable units; one dealing with landfill contents and the other with groundwater. The Proposed Plan announced Alternative 4 (containment-soil/clay cap), which also includes the Site restrictions of Alternative 2, as the U.S. EPA's preferred remedial action alternative for the landfill contents operable unit. Remedial action on the groundwater operable unit was deferred until the effectiveness on the landfill contents remedial action could be measured.

After the Public Comment Period and comments from the Community were received, no significant changes were made to the U.S. EPA's preferred alternative for the landfill contents operable unit (Alternative 4) and the deferring of the selection of a remedy for the groundwater operable unit.

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EVALUATION FACTOR	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 SITE RESTRICTIONS	ALTERNATIVE 3 CONTAINMENT (SURFACE CONTROLS)	ALTERNATIVE 4 CONTAINMENT (SOIL-CLAY CAP)	ALTERNATIVE 5 GROUNDWATER COLLECTION AND TREATMENT	ALTERNATIVE 6 REMOVAL, TREATMENT AND DISPOSAL
Reliability of Controls	Not applicable	Access restrictions would be reliable, but could be violated by trespassers. Monitoring would be reliable for detecting contaminant release, but would not prevent release or migration	Access restrictions and monitoring same as Alternative 2. Landfill cap would be reliable for reducing leachate generation, but would not prevent contaminant release. Small likelihood of failure given annual maintenance.	Same as Alternative 3	Access restrictions same as Alternative 2 Groundwater collection and treatment would be reliable given proper operation and maintenance	Access restrictions same as Alternative 2 Groundwater collection and treatment would be reliable given proper operation and maintenance Fixation of landfill contents and disposal in RCRA type facility would be reliable at immobilizing contaminants
REDUCTION OF TOXICITY, MOBILITY AND VOLUME	No reduction	No reduction.	Mobility would be reduced by limiting leachate generation; no reduction in toxicity or volume.	Similar to Alternative 3, except for greater reduction of mobility	Volume and mobility of groundwater contaminants would be reduced, toxicity might not be reduced	Volume and mobility of groundwater contaminants would be reduced, toxicity might not be reduced Mobility of hazardous materials in landfill reduced, volume and toxicity would not be
IMPLEMENTABILITY						
Technical Feasibility	Not applicable	Access restrictions would be easy to implement but trespassing could not be monitored. Monitoring program could be implemented with no technical difficulty. Potential spread of groundwater contaminant plume could make future pump and treat actions more difficult. Alternate water supply could be implemented in future.	Same access restrictions and monitoring program as Alternative 2. Surface controls would be easy to implement with some quality control. Some leachate reduction should limit spread of groundwater contaminant plume to make future pump and treat actions easier to implement. Alternate water supply could be implemented in future.	Similar to Alternative 3, except soil-clay cap slightly more difficult to install. Large reduction in leachate generation should limit spread of groundwater contaminant plume more than Alternative 3. Future pump and treat actions or alternate water supply would be easy to implement if needed.	Groundwater collection system would be difficult to implement because of complex site hydrogeology, may adversely affect nearby wells. Treatment system would be implemented with some difficulty. Future remedial action would be limited to removal of contaminant source (landfill contents).	Groundwater collection and treatment as per Alternative 5. Removal treatment and disposal would be very difficult to implement because of various waste types that require handling and construction staging requirements. Future remedial action should not be needed
Administrative Feasibility	No change from present status.	Coordination with local agencies will be required to maintain legal restrictions; permits not required for onsite work.	Same as Alternative 2	Same as Alternative 2.	Similar to Alternative 2, except coordination with state and federal agencies would be required to establish clean-up levels and discharge standards.	Same as Alternative 5
Availability of Services and Equipment	Not applicable	Services and materials locally available.	Same as Alternative 2.	Same as Alternative 3.	Equipment and services would be available, but not locally.	Equipment and services would be of limited availability
COST						
Capital Cost	None	$170,000	$ 810,000	$1,800,000	$ 4,300,000	$34,000,000
Operation and Maintenance Cost	None	$530,000	$ 770,000	$1,000,000	$ 8,000,000	$ 9,000,000
Present Worth at 5% Discount Rate Over 30 Years	None	$700,000	$1,600,000	$2,800,000	$12,000,000	$43,000,000
COMPLIANCE WITH ARARs						
Compliance with ARARs	Would not meet ARARs for: • landfill closure for hazardous waste facility • MCL for benzene and 1-1 dichloroethane	Same as Alternative 1.	Same as Alternative 1.	Would not meet ARARs for: • MCL for benzene and 1-1 dichloroethane	ARARs would be complied with.	ARARs would be complied with
Appropriateness of waivers	Not appropriate since monitoring would be required to detect potential spread of groundwater contaminant plume.	May be appropriate. Residential wells are not currently contaminated, monitoring program would track the spread of the groundwater contaminant plume and signal if future remedial action is necessary.	Similar to Alternative 2. Would provide additional justification because of reduced leachate generation.	Similar to Alternative 3, with more justification because soil-clay cap further reduces leachate generation.	Not necessary	Not necessary

TABLE 8 . (PAGE 2 O
EVALUATION AND ARISON
OF REMEDIAL ALT IVES
MASON COUNTY LANDFILL FS

EVALUATION FACTOR	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 SITE RESTRICTIONS	ALTERNATIVE 3 CONTAINMENT (SURFACE CONTROLS)	ALTERNATIVE 4 CONTAINMENT (SOIL-CLAY CAP)	ALTERNATIVE 5 GROUNDWATER COLLECTION AND TREATMENT	ALTERNATIVE 6 REMOVAL, TREATMENT AND DISPOSAL
SHORT-TERM EFFECTIVENESS						
Time Until Protection is Achieved After ROD Signing	Protection not achieved	Site fence and monitoring wells could be installed in 3 to 6 months, allowing time for bidding. Monitoring expected to continue beyond 30 years.	Surface controls could be accomplished in 1 to 2 years, allowing time for design, bidding, construction, and downtime during winter.	Soil clay cap could be installed in 1 to 2 years allowing time for design, bidding, construction, and downtime during winter.	Soil clay cap could be installed in 1 to 2 years allowing time for design, bidding, construction, and downtime during winter Groundwater collection and treatment system would take 2 to 4 years for pilot tests, design and construction. Pumping expected to continue beyond 30 years.	Onsite RCRA landfill would take 5 to 10 years for design, construction, and filling, allowing time for material handling, sorting and staging, fixation, and downtime during winter Groundwater collection and treatment system would take 2 to 4 years for pilot tests, design and construction. Pumping expected to continue beyond 30 years
Protection of Community During Remedial Actions	No action taken.	Action would have little effect on nearby residents.	Increase of dust during earthwork activities would be mitigated by dust suppressants. Increase of local traffic while hauling soil to site, vehicles would be decontaminated before leaving site as appropriate	Similar to Alternative 3, except for more traffic and dust because of increased earthwork quantities.	Similar to Alternative 4, except for hauling of contaminated groundwater to POTW until treatment plant is in operation	Substantial increase in dust during excavation and staging of landfill contents would be mitigated by dust and VOC suppressants
Protection of Workers	No action taken.	Landfill contents would not be disturbed. Workers would be health and safety trained. Air would be monitored during onsite work.	Similar to Alternative 2, slight risk of exposure to landfill contents during regrading	Same as Alternative 3	Similar to Alternative 3, except for more potential exposure to contaminated groundwater. Potential exposure to contaminated sludges and spent carbon for life of the action.	Substantial increase in exposure to contaminants by direct skin contact, inhalation and ingestion during excavation and sorting
Environmental Impacts During Remedial Actions	No action taken.	Little environmental impact, some trees would be removed.	Some trees would be removed. Runoff control measures would reduce adverse effects to Iris Creek.	Same as Alternative 3	Substantial effects to marshy area and Babbin Pond from nearby pumping. Discharge to Iris Creek would be monitored, measures to control flow in Iris Creek could be needed because of discharge rates.	Similar to Alternative 5, except for high potential for runoff or wind erosion during staging of landfill contents
LONG-TERM EFFECTIVENESS AND PERMANENCE						
Magnitude of Residual Risk	Potential for direct contact with contaminated soil and sediment. Potential for direct contact with landfill contents under future development setting. Potential for ingestion of contaminated groundwater if contaminant plume spreads to residential wells. Risk levels identified in baseline risk assessment.	Would prevent direct contact with onsite contaminants in soil, sediment, and landfill contents. Trespassers could violate access restrictions. Spread of contaminant plume would be monitored and documented. No reduction of leaching of contaminants to groundwater; no reduction of groundwater contamination.	Similar to Alternative 2, except leachate generation would be reduced about 60 percent	Similar to Alternative 2, except leachate generation would be reduced about 80 percent	Similar to Alternative 4, except migration of contaminated water would be prevented and groundwater contamination would be reduced (below MCLs or AWQC)	Similar to Alternative 5, except mobility of contaminants would be virtually eliminated. Contaminants would remain onsite
Adequacy of Controls	No protection against present or future risks caused by onsite contaminants.	Fence would be susceptible to vandalism and would require periodic inspection and maintenance. Groundwater monitoring would track movement of contaminant plume and signal if groundwater contamination posed a threat to nearby residential wells; future action could be taken.	Site fence and groundwater monitoring same as Alternative 2. Landfill cap would be susceptible to cracking from desiccation, frost action and settlement, annual inspection and maintenance required, repairs easy to implement.	Site fence and groundwater monitoring same as Alternative 3. Groundwater barrier layer of cap would be protected from environment, but susceptible to settlement, repair more difficult than for Alternative 3, and replacement might be necessary in 30 years.	Site fence same as Alternative 2 Groundwater collection and treatment would require daily monitoring and inspection to ensure effectiveness; offsite disposal of sludge and spent carbon would remove contaminants from site, monitoring downgradient of collection system will be needed to ensure effectiveness	Site fence same as Alternative 2 Groundwater collection and treatment would require daily monitoring and inspection to ensure effectiveness, offsite disposal of sludge and spent carbon would remove contaminants from site; monitoring downgradient of collection system will be needed to ensure effectiveness RCRA type landfill is proven technology for containing wastes given inspection and maintenance. Fixation would effectively reduce mobility of hazardous substances

TABLE 6 (PAGE 1 OF 3)
EVALUATION AND COMPARISON
OF REMEDIAL ALTERNATIVES
MASON COUNTY LANDFILLS

EVALUATION FACTOR	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 SITE RESTRICTIONS	ALTERNATIVE 3 CONTAINMENT (SURFACE CONTROLS)	ALTERNATIVE 4 CONTAINMENT (SOIL-CLAY CAP)	ALTERNATIVE 5 GROUNDWATER COLLECTION AND TREATMENT	ALTERNATIVE 6 REMOVAL, TREATMENT AND DISPOSAL
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT						
Reduction of Existing and Future Risk	Would not reduce existing or future risk	Risk of direct human contact with contaminants in soil, sediment, landfill contents and groundwater would be substantially reduced. Site and aquifer would remain contaminated. Future risk of residential well contamination would be limited by monitoring program. Potential risk to environment would exist because of the release of contaminated groundwater to Iris Creek.	Similar to Alternative 2; some reduction in aquifer contamination because leachate generation would be limited, reducing risk to public health and environment	Similar to Alternative 3, with more reduction of leachate generation and resulting aquifer contamination	Similar to Alternative 4, with substantial reduction risk from contaminated groundwater by migration control using groundwater	Similar to Alternative 5, with additional minimization of contaminants through source controls
Prevention of Future Exposure to Residuals	Future exposures would not be prevented	Human exposure to contaminated media on site would be limited and controlled by access restrictions and monitoring. Potential would exist for release of contaminants to environment from groundwater discharge.	Similar to Alternative 2, with less potential for release of contaminants from groundwater discharge	Similar to Alternative 3, with less potential for release of contaminants from groundwater discharge	Similar to Alternative 4, except threat of releases to the environment would be controlled	Similar to Alternative 5
Overall Protection	None	Would provide substantial protection for human health, but no protection for environment. Protection would not be permanent and would require maintenance	Similar to Alternative 2, with some protection of the environment	Similar to Alternative 3, with greater protection of the environment	High degree of protection for human health and the environment. Protection would not be permanent and would require maintenance and replacement	Same as Alternative 5

TABLE 6 (PAGE 3 OF 3)
EVALUATION AND COMPARISO
OF REMEDIAL ALTERNATIVES
MASON COUNTY LANDFILL #1

Table 7 (Page 1 of 3)
ARARs FOR THE MASON COUNTY LANDFILL

Regulation	Requirement	Regulated Action or Condition	Alternative 1	2	3	4	5	6
FEDERAL								
Clean Air Act, Section 101	Implementation of regional air pollution control programs.	Emissions during excavation. Possibly gas vent emissions.	X	X	X	X	X	X
40 CFR 52	Rules for implementation of regional air quality plan.	Emissions during excavation. Possibly gas vent emissions.	X	X	X	X	X	X
40 CFR 50	Air quality standards.	Emissions during excavation. Possibly gas vent emissions.	X	X	X	X	X	X
Clean Water Act, Section 208	Actions consistent with regional water quality management program.	Discharges to Iris Creek.					X	X
40 CFR 122	NPDES permit regulations.	Discharges to Iris Creek.					X	X
40 CFR 125	Criteria for NPDES permit.	Discharges to Iris Creek.					X	X
40 CFR 131	Enforcement jurisdiction over discharges granted to states.	Discharges to Iris Creek.					X	X
40 CFR 136	Adherenece to sampling procedures.	Discharges to Iris Creek.					X	X
40 CFR 257	Standards for solid waste disposal facility; management delegated to states.	U.S. EPA to determine if Subtitle D landfill closure is appropriate.	X	X	X	X	X	X
40 CFR 261	Definition and identification of hazardous waste.	Excavated materials and groundwater treatment residuals.					X	X
40 CFR 262	Regulations for generators of hazardous waste.	Groundwater treatment residuals hauled offsite.					X	X
40 CFR 263	Regulations for transport of hazardous waste.	Groundwater treatment residuals hauled offsite.					X	X
40 CFR 264.1 through .117(C)	Regulations for closure of a hazardous waste site.	U.S. EPA to determine if Subtitle C closure regulations are appropriate.	X	X	X	X	X	X
40 CFR 264.191 through .198	Regulations for tank storage of hazardous waste.	Groundwater treatment system tanks.					X	X

Table 7 (Page 2 of 3)

Regulation	Requirement	Regulated Action or Condition	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
40 CFR 264.301 through .314	Rules for construction, maintenance and closure of a hazardous waste landfill	Construction and closure of a RCRA type landfill				X	X	X
40 CFR 264 Subpart X	Standards for environmental performance of miscellaneous treatment units.	Physical/chemical treatment.						X
40 CFR 268 Subparts C and D	Land-banned waste materials.	Would apply to certain solvent-containing wastes if present in landfill contents.						X
40 CFR 403	Pretreatment standards for discharge to local POTW.	Discharges to POTW after installation of extraction wells but before installation of onsite groundwater treatment plant.					X	X
40 CFR 141	Establishes maximum contaminant levels for drinking water quality.	Groundwater at the site.		X	X	X	X	X
Executive Order 12372, 40 CFR 29	Requires state and local coordination and review of EPA-assisted projects.	Mason County Landfill is a CERCLA site.		X	X	X	X	X
Executive Orders 11988 and 11990, 40 CFR 6, Subpart A	Avoids adverse affects to flood plain or wetlands and evaluates potential impacts to those areas.	Groundwater extraction and collection will probably "dry up" the marshy area near Babbin Pond.					X	X
Fish and Wildlife Coordination Act	Protects fish and wildlife when natural stream is modified.	Discharges to Iris Creek.					X	X
STATE								
ACT 348	Regulates air emissions and requires monitoring of air.	Handling and treatment of landfill contents; gas vent emissions.	X	X	X	X	X	X
ACT 315	Regulates permitting, construction, and abandonment of wells.	Monitoring wells onsite and near site. Groundwater extraction wells.	X	X	X	X	X	X
ACT 641	Regulates the disposal of nonhazardous waste.	May be appropriate for landfill closure.	X	X	X	X	X	X
ACT 64, Parts 2 and 3	Requirements for identification, recordkeeping, and management of hazardous waste.	Generated groundwater treatment residuals and excavated landfill contents.					X	X

Table 7 (Page 3 of 3)

Regulation	Requirement	Regulated Action or Condition	Alternative 1	2	3	4	5	6
ACT 64, Part 5	Regulations for construction and licensing a new hazardous waste facility.	Onsite RCRA-type landfill.						X
ACT 64, Part 6	Specifies technical standards for locating operating and closing a hazardous waste facility.	Onsite RCRA-type landfill and containers or tanks used for treatment may be appropriate for landfill closure.	X	X	X	X	X	X
ACT 136 ACT 64, Part 4	Requirements for transport of liquid or solid waste offsite.	Hauling contaminated groundwater to local POTW during installation of groundwater collection and treatment system. Transport of groundwater treatment residuals.					X	X
ACT 347, Rule 1704	Requires a soil erosion and sedimentation plan for earth changes within 500 feet of a lake or stream.	Erosion control measures along north slope of landfill and construction activities for groundwater collection and treatment systems.			X	X	X	X
ACT 245, Part 9	Rules for reporting discharges to state waters.	Discharges from groundwater treatment plant.					X	X
ACT 245, Part 21	Rules for NPDES permit.	Discharges from groundwater treatment plant.					X	X
ACT 98	Supervision and control of severage systems.	Construction and operation of groundwater treatment plant.					X	X
ACT 203	Regulates activities that affect wetland areas.	Construction and operation of groundwater collection system; discharges to Iris Creek.					X	X
ACT 346, Section 3	Permit for construction in "bottom land."	Buried pipeline for groundwater collection and discharge.					X	X

"X" indicates that regulation is applicable or relevant and appropriate.

GLT806/1

Table 8
COST ESTIMATE SUMMARY

	Alternative				
Description	2	3	4	5	6
Site Fence	$ 67,000	$ 67,000	$ 67,000	$ 67,000	$ 67,000
Monitoring Well Installation	21,000	21,000	21,000	21,000	21,000
Surface Controls	0	345,000	0	0	0
Soil-Clay Cap	0	0	868,000	868,000	0
Groundwater Collection	0	0	0	184,000	184,000
Groundwater Treatment	0	0	0	937,000	937,000
Excavation	0	0	0	0	4,026,000
Onsite Fixation	0	0	0	0	8,749,000
Onsite RCRA Landfill	0	0	0	0	2,711,000
Allowances[a]	11,000	52,000	115,000	353,000	2,838,000
Other Costs[b]	67,000	322,000	687,000	1,840,000	14,668,000
Direct Capital Cost	$166,000	$807,000	$1,758,000	$4,270,000	$34,201,000
Present Worth of O&M Costs[c]	530,000	765,000	1,070,000	7,970,000	9,100,000
Total Present Worth Estimate[d]	$700,000	$1,600,000	$2,800,000	$12,000,000	$43,000,000

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[a] Allowances consist of mobilization/demobilization and a field detail allowance. See Appendix D for detailed breakdown.

[b] Other costs consist of contingencies for bid and scope items and allowances for administrative services, engineering design, and services during construction. See Appendix D for detailed breakdown.

[c] Present worth estimates assume a discount rate of 5 percent annually over a period of 30 years.

[d] Cost estimate is order-of-magnitude level with expected accuracy of +50 percent to -30 percent. Total present worth estimate is rounded to two significant figures.

GLT626/81

X. SELECTED REMEDY AND STATUTORY DETERMINATIONS

A. Landfill Contents Operable Unit

The selected remedy for the landfill contents operable unit is Alternative 4 which includes the containment of the landfill contents by means of a soil/clay RCRA subtitle C compliant cap, Site restrictions and groundwater monitoring.

Alternative 4 is protective of human health and the environment, attains or defers applicable or relevant and appropriate requirements promulgated under Federal and State environmental laws and is cost effective. Alternative 4 is not the final remedial action for the Site but is consistent with the final remedy. The final remedy at the Site will include the remedial action alternative from the landfill contents operable unit (Alternative 4) and the remedial alternative chosen after the groundwater operable unit is completed.

1. Protection of Human Health and the Environment.

Alternative 4 provides protection of human health and the environment through the use of containment of landfill contents and institutional controls such as Site access restrictions. Protectiveness is achieved with the upgrading of the present cap to a RCRA compliant, subtitle C, soil/clay cap. The cap is a reliable method to alleviate the direct contact threat from the landfill contents. The RCRA compliant cap is estimated to reduce leachate generation by ninety percent, which in turn should lower the amount of contamination reaching the groundwater. Also, by reducing the concentrations of contaminants reaching the groundwater, less contamination will reach the surface water bodies near the Site (the wetlands, Babbin Pond and Iris Creek).

Since untreated wastes will remain within the landfill, the groundwater will continue to be monitored to ensure the protectiveness of the selected operable unit remedy. The results of this monitoring will also aid in determining the remedy for the groundwater operable unit.

The institutional controls implemented from Alternative 2 will aid in achieving the protectiveness to human health and the environment. The Site access restrictions (Site fence and warning signs) will reduce public health risks by preventing public contact with buried waste, landfill gases, contaminated sediment and surface soil. The Site access restrictions will also help protect the integrity of the landfill cap by limiting vehicle access. The continued groundwater monitoring will track and document the nature and extent of contamination migration. Deed restrictions will prohibit future Site development and the installation of water supply wells on and near the Site.

No treatment technologies are being applied to reduce toxicity, mobility or volume of hazardous waste with the implementation of Alternative 4, so the permanence of this interim remedy depends on the maintaining of the integrity of the upgraded cap. Also, with the installation of the RCRA subtitle C compliant soil/clay cap, leachate production is anticipated to be reduced by ninety percent, thereby reducing the volume of contaminants reaching groundwater and indirectly reducing the mobility and toxicity of contamination in the groundwater.

2. Attainment of Applicable or Relevant and Appropriate Requirements of Environmental Laws.

Alternative 4 will be designed to meet all the applicable, or relevant and appropriate requirements (ARARs) of Federal and more stringent State environmental laws. ARARs, including maximum containment levels (MCLs) in groundwater, may be met with the implementation of Alternative 4, but the MCLs will not be addressed until the conclusion of the groundwater operable unit. Table 7 lists the ARARs that apply to each of the alternatives and the following discussion provides the details of the ARARs that will be met by Alternative 4.

a. Federal: Resource Conservation and Recovery Act

RCRA closure and post-closure requirements for landfills with hazardous wastes are outlined in 40 CFR Subpart G. Section 264.310 of RCRA, Subpart N, specifies the performance-based requirements for a cover at final landfill closure. The cover in Alternative 4 will be a cap as prescribed in RCRA guidance and will comply with RCRA regulations. The cap will minimize migration of liquid through the landfill, function with minimum maintenance, promote drainage, minimize erosion, accommodate settling, and be less than or equal to the permeability of natural subsoils present.

After closure is completed, the substantive monitoring and maintenance post-closure requirements contained in Section 264.117 through 264.120 of Subpart G will be conducted. The facility will be closed according to the standards in Subpart G, Section 264.111-closure performance standards. After the closure activities have concluded, a survey plat, as prescribed in Subpart G, Section 264.116, indicating location and dimensions of the disposal area will be submitted to the local zoning authority, or to the authority with jurisdiction over local land use, and the Regional Administrator and the Michigan State Director.

b. State: Hazardous Waste Management Act (Act 64)

To the extent that Act 64 is more stringent than the Federal RCRA regulation, Act 64 will be followed.

Relative to landfill closure provisions, Act 64, Rule 619 specifies the closure standards, including a minimum cover requirement, and requirements for venting, which will be followed.

c. Federal: Clean Air Act

The Clean Air Act (CAA) identifies and regulates pollutants that could be released during earth-moving activities associated with landfill regrading and cap installation. CAA Section 109 outlines the criteria pollutants for which National Ambient Air Quality Standards have been established. The CAA is an ARAR and the regulation standards will be complied with during the implementation of Alternative 4.

d. State: Air Pollution Act (Act 348)

Under Act 348 Rule 901, the Michigan Air Quality Division exercises its authority to ensure that a person does not cause or permit the emission of an air contaminant in quantities that will cause "injurious effects to human health or safety, animal life, plant life of significant economic value or property" or "unreasonable interference with the comfortable enjoyment of life and property." Also, Rules 371 and 373 address fugitive dust programs and control methods for emissions of dust from a variety of sources including haul trucks, roads and stockpiles of materials.

e. Federal: Occupational Safety and Health Administration Act (OSHA)

The selected remedial action contractor must develop and implement a health and safety program for its workers if such program does not already exist. All on-site workers must meet the minimum training and medical monitoring requirements outlined in 40 CFR 1910.

f. Federal: Executive Orders 11988 and 11990 and the Fish and Wildlife Coordination Act

Executive Orders 11988 and 11990 and the Fish and Wildlife Coordination Act pertain to the protection of flood plains and wetlands and protect fish and wildlife if the wetlands or natural streams are modified. The provisions of these Orders and Act will be implemented if during the design phase of the remedial action, they are determined to be applicable or relevant and appropriate.

g. State: Michigan Water Resources Act (Act 245)

Act 245, Part 21 requires that any remedial action in which site runoff would be channeled directly to a surface water body via a ditch, culvert, storm sewer, or other means shall be governed by this Act. The provisions of this Act will be met at this site to the extent that it applies as determined by the MDNR after the design stage is completed.

h. State: Mineral Well Act (Act 315)

Act 315 and the Administrative Rules require that test wells be permitted, constructed property, recorded, and properly plugged upon abandonment. This Act is an ARAR and treatment of all test wells will be dictated by it.

i. State: Soil Erosion and Sedimentation Control Act (Act 347)

Under Rule 1704 of this Act, a soil erosion control and sedimentation plan is required for any earth change within 500 feet of a lake or stream. This Act and its Rule call for soil erosion and sedimentation control procedures and measures to minimize such erosion and sedimentation. The erosion control measures along the north slope of the landfill will meet the requirements of this Act.

j. Other Federal and State ARARs

Since Alternative 4 is an interim remedy, directly addressing only the landfill contents operable unit, ARARs concerning groundwater, such as 40 CFR 141, regarding MCLs, and ARARs concerning the surface waters, such as the Clean Water Act are being deferred until a remedy is selected for the groundwater operable unit. Alternative 4 may indirectly address these other ARAR concerns but the degree cannot be determined at this time.

All Federal and State ARARs will be satisfied by the final Site remedial action which will be selected after the groundwater operable unit is complete.

3. Cost-Effectiveness.

Alternative 4 affords a high degree of effectiveness by providing protection against direct contact threats and the threat of releases to the groundwater. The cost of Alternative 4 is $1.8 million with a present worth, including operation and maintenance, of $2.8 million over thirty years. Alternative 4 is less costly to implement and maintain than Alternatives 5 and 6, and provides protection for human health and the environment. The additional costs of Alternatives 5 and 6 can not be justified at this time since Alternative 4 may address the groundwater concerns. Additional costs may be incurred depending upon the outcome of further studies at the site involving the groundwater operable unit. By providing a greater reduction in leachate generation than Alternative 3, Alternative 4 may reduce future costs associated with groundwater remediation more than Alternative 3.

4. Utilization of Permanent Solutions, Alternative Treatment Technologies to the Maximum Extent Practicable, and Preference for Treatment as a Principal Element.

Although the selected remedy for the landfill contents operable unit will reduce leachate generation by an estimated ninety percent, Alternative 4 does not utilize any permanent solutions or alternative treatment technologies. Alternative 4 is considered to be an interim remedy to address the landfill contents operable unit, one that will be consistent with the final overall site remedy. Alternative 5 and 6 offer greater degrees of permanence and alternative treatment technologies, but Alternative 5 is not feasible at this time since Alternative 4 may address the groundwater contamination concerns that would be addressed by Alternative 5; Alternative 6 is deemed impractical because of the quantity and heterogeneous nature of the landfill contents. Depending on the effectiveness of Alternative 4, alternative treatment technologies may be applied as part of the final remedy at this Site.

B. Groundwater Operable Unit

This Record of Decision selects a remedy to address the landfill contents operable unit; this remedy calls for the installation of an upgraded, RCRA compliant cap and institutional controls. As the selected landfill contents operable unit remedy (Alternative 4) will indirectly address groundwater concerns, the effectiveness of the upgraded cap needs to be measured prior to selecting a remedy to address the groundwater operable unit. Alternative 4 indicates that four additional groundwater monitoring wells will be installed to help define the geological conditions at the Site. A total of twenty monitoring wells will be sampled on a semi-annual basis.

To enable a final remedy to be selected for the Site, the remedial investigation regarding the groundwater operable unit needs to be continued until the effectiveness of Alternative 4 can be measured. To fully evaluate the effectiveness of Alternative 4 and to establish enough justification to select a remedy for the groundwater operable unit, further monitoring of the twenty groundwater monitoring wells, as noted above, will be conducted, as well as, the further monitoring of residential wells, gas vents, and surface water and sediments within the wetlands, Babbin Pond and Iris Creek. To enable a most current baseline of groundwater contamination and site conditions, and to provide continued protection of human health and the environment, the groundwater operable unit monitoring program will begin prior to the design and construction of the RCRA compliant cap. The specific requirements of the continued remedial investigation for the groundwater operable unit will be established during the design stage of the selected landfill contents remedial action.

XI. STATE ISSUES

The Michigan Department of Natural Resources (MDNR) has concurred with this Record of Decision (ROD). This concurrence is conditional upon the incorporation of their concerns and comments into this ROD as stated in their September 13, 1988 letter to the U.S. EPA. (See Attachment 1)

These concerns and comments have been addressed in this ROD or will be addressed during the design phase of the project, as noted in the letter of September 20, 1988 from the U.S. EPA to the MDNR (See Attachment 2).

XII. SUMMARY

Considering the various evaluation factors in SARA Section 121(b) and the National Contingency Plan, selecting Alternative 4 for the landfill contents operable unit and the deferring of the selection of a remedial alternative for the groundwater operable unit until the effectiveness of Alternative 4 can be measured, offers a cost-effective solution to the contaminant problems at the Site. Alternative 4 either satisfies the Federal and State ARARs or defers them until a final remedy is selected after the conclusion of the groundwater operable unit.

Alternative 4 is an interim remedial action that is consistent with a final remedy for this site and provides adequate protection of human health and the environment. Another Proposed Plan and Record of Decision will be issued at the conclusion of the ongoing remedial investigation involving the groundwater operable unit to announce and select a final remedy for the Mason County Landfill.

The cost of Alternative 4 is $1.8 million, with a present worth, including operation and maintenance, of $2.8 million over thirty years. The cost of a final remedial action can not be fully determined until a remedy is chosen to address the groundwater operable unit.

ATTACHMENT 1

STATE OF MICHIGAN

JAMES J. BLANCHARD, Governor

DEPARTMENT OF NATURAL RESOURCES

STEVENS T. MASON BUILDING
BOX 30028
LANSING, MI 48909

~~GORDON E. GUYER, Director~~
David F. Hales, Director

NATURAL RESOURCES COMMISSION
THOMAS J. ANDERSON
MARLENE J. FLUHARTY
KERRY KAMMER
O. STEWART MYERS
DAVID D. OLSON
RAYMOND POUPORE

RECEIVED
SEP 19 1988
REMEDIAL & ENFORCEMENT
RESPONSE BRANCH

September 13, 1988

Ms. Mary Gade
U.S. Environmental Protection Agency
Remedial and Enforcement Response Branch
5HR-11
230 South Dearborn Street
Chicago, Illinois 60604

Dear Ms. Gade:

The Draft ROD received August 17, 1988, regarding the Mason County Landfill site in Ludington, is conditionally acceptable. I would like to have the following concerns and comments incorporated into the final ROD as the State's response for this site.

1. The proposal to fence the entire site does not seem practical given the limited potential for exposure to contaminants. We prefer that alternatives to fencing such as landscape modifications or some other reasonable alternative be considered prior to the selection of fencing.

2. There should be institutional controls provided such as deed restrictions or restrictive covenants to assure that land uses are controlled.

3. Groundwater monitoring as part of the deferred groundwater operable unit should be funded and initiated prior to design and construction of the RCRA compliant cap. Monitoring data should enable the involved agencies and PRP's to better evaluate the effectiveness of the cap by providing current background conditions at the site.

4. On page 25, add as a potential problem the fact that subsidence has already caused the cap to fail. A drainage system such as perforated pipe would fail if the clay layer below it subsides.

Finally, the State of Michigan encourages EPA to pursue PRP involvement by using all means available including issuing a Section 106 Administrative Order to all viable potentially responsible parties.

Attached is a letter to Mr. Dan Cozza regarding the State's position concerning the Proposed Plan received July 19, 1988. Please let me know if you have questions.

Sincerely,

Gary E. Guenther, Chief
Environmental Response Division
517-373-4823

Attachment

cc: ✓Mr. Dan Cozza, U.S. Environmental Protection Agency
Mr. William Bradford, Acting Chief, Remedial Action Section
Mr. Peter Ollila/Mr. Bill Herceg/Mason County Landfill file

ATTACHMENT 2

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

REPLY TO THE ATTENTION OF:

SEP 20 1988

Mr. Gary E. Guenther
Michigan Department of Natural Resources
Stevens T. Mason Bldg.
Box 30028
Lansing, Michigan 48933

5HS-11

RE: Mason County Landfill ROD

Dear Mr. Guenther:

Thank you for your concurrence on the Mason County Landfill Record of Decision (ROD). It is understood that this concurrence is conditional upon the incorporation of your concerns and comments into the ROD, as addressed in your letter of September 13, 1988. As this letter addresses those concerns and indicates how your concerns have been or will be addressed, it is assumed that your conditions of concurrence have been met.

Below are your concerns followed by the U.S. EPA's response.

1) MDNR concern:
Alternatives to fencing the entire site should be considered.

U.S. EPA response:
The sentence, "Alternatives to the site fence will be considered if they are determined to adequately protect the landfill cap integrity and keep trespassers away from the area of the on-site gas vents", has been added to the Alternative 2 (site restrictions) description in Section VI-B of the ROD. Alternative 4 (the chosen alternative) uses the site restrictions as described within Alternative 2.

2) MDNR concern:
There should be institutional controls provided such as deed restrictions or restrictive covenants to assure that land uses are controlled.

U.S. EPA response:
Deed and zoning restrictions are mentioned in the description of Alternative 2 within Section VI-B of the ROD. These restrictions pertain only to site property use, while off-site property restrictions may be necessary in the future. Because there is no federal authority to implement deed or zoning restrictions, state and local governments would have to be coordinated with to pursue these options.

3) MDNR concern:
Groundwater monitoring as part of the deferred groundwater operable unit should be funded and initiated prior to design and construction of the RCRA compliant cap. Monitoring data should enable the involved agencies and PRPs to better evaluate the effectiveness of the cap by providing current background conditions at the site.

U.S. EPA response:
The sentence, "To enable a most current baseline of groundwater contamination and site conditions, and to provide continued protection of human health and the environment, the groundwater operable unit monitoring program will be initiated prior to the design and construction of the RCRA compliant cap" has been added to the last paragraph in Section X-B of the ROD.

4) MDNR concern:
It should be mentioned that another implementation problem associated with Alternative 4 would be that since subsidence has caused the present cap to fail, subsidence of the new clay cap will cause any drainage system, such as perforated pipe, to fail.

U.S. EPA response:
This concern has been noted within the description of Alternative 4 implementation in Section VI-B of this ROD and will be reviewed during the design phase.

5) MDNR concern:
The State of Michigan encourages EPA to pursue PRP involvement by using all means available including issuing a Section 106 Administrative Order to all viable potentially responsible parties.

U.S. EPA response:
Special Notice Letters for RD/RA negotiations have already been sent to six PRPs on August 24, 1988. If the negotiations are not successful, other means of enforcment will be considered.

If you have any questions or further comments regarding this letter or the Mason County Landfill ROD, please let me know.

Sincerely,

Norman Niedergang
per Mary A. Gade
Acting Associate Director
Office of Superfund

cc: D. Cozza, WMD
M. Radell, ORC
B. Herceg/P. Ollila, MDNR

ATTACHMENT 3

RESPONSIVENESS SUMMARY

MASON COUNTY LANDFILL
MASON COUNTY, MICHIGAN

The U.S. Environmental Protection Agency (U.S. EPA) has gathered information on the types and extent of contamination found, evaluated remedial measures, and has recommended a remedial action at the Mason County Landfill. As part of this process, a public meeting was held to explain the intent of the project, to describe the results, and to receive comments from the public.

Public participation in Superfund projects is required in the Superfund Amendments and Reauthorization Act of 1986 (SARA). Comments received from the public are considered in the selection of the remedial action for the site. The Responsiveness Summary serves two purposes: to provide the U.S. EPA with information about community preferences and concerns regarding the remedial alternatives and to show members of the community how their comments were incorporated into the decision making process. Comments regarding information specifically contained in the RI/FS are not addressed in this Responsiveness Summary as this information is contained in the reports available for public viewing at the Ludington Library.

This document summarizes the oral comments received at the public meeting held August 17, 1988, and the written comments received during the public comment period August 8, 1988 to August 31, 1988. Each comment is followed by a letter which refers to the originator(s) of the comment. Please refer to Appendix A for a complete list of respondents. The Responsiveness Summary addresses concerns in the following general areas:

1. Design concerns.
2. Implementation concerns.
3. Environmental Impact/Risk Assessment concerns.
4. Funding concerns.
5. Property value concerns.
6. Notification period and response time concerns.

Individual comments have been summarized and grouped in these six general areas. U.S. EPA responses follow each comment.

1. Design concerns

1.a. Comment

The north end of the landfill was exposed at one time and just covered over. There is no cap to upgrade, or repair. How will that be dealt with? (see A in Appendix A)

1.a. Response

The specifics of the cap will be examined in the design stage of the remedial action. If there was no cap in one section, Alternative 4 suggests the cap be a specific uniform thickness throughout, so a new cap would be built in that area.

1.b. Comment

Has a permeability test been done on the existing landfill cap since the existing cap will be incorporated into the Alternative 4 clay cap? And, if the existing clay cap does not meet RCRA requirements, will this alter the quantity of clay and the cost of the remedy? (E)

1.b. Response

Permeability tests were not conducted on the existing cap during the RI/Fs. It is possible that the existing clay may have to be reworked and that more clay than estimated may be needed, increasing the estimated cost. These questions will be addressed as part of the design phase.

1.c. Comment

The design of the soil/clay cap for the landfill specifies the placement of 1.5 feet of topsoil and fill material above the geotextile fabric. Depending upon the depth of the frost line in the area, this depth may be insufficient to permit the permanent establishment of soil invertebrate populations, particularly earthworms. This in turn may hamper the viability of a permanent vegetative cover on the cap. It may be necessary to increase the depth of the topsoil and fill layers so as to create a suitable environment for the soil amending invertebrates.

A permeability rating of 10^{-7} cm/sec is expected of the clay layer in the soil/clay layer, provided the clay layer is protected from the frost and wet/dry cycles. Is the three feet of topsoil, fill, and sand to be placed above the clay layer sufficient protection in this area of

Michigan? Additional material may be necessary to provide adequate protection for the clay layer. (L)

1.c. Response

Both of these comments will be addressed in the pre-design and design phases of the remedial action.

1.d. Comment

The RI report indicates that surface runoff/percolation of precipitation will be collected from the soil/clay cap and discharged to Iris Creek. Under pristine conditions, surface water runoff and groundwater recharge at the site would discharge to and sustain the wetlands adjacent to Babbin Pond. Removal of this water source, coupled with possible future extraction of groundwater for treatment, threatens to "dry up" the wetland area, as identified in the FS study. One way to minimize this impact is to redirect the collected surface runoff/percolation waters to the wetland area rather than to Iris Creek, which is further downgradient. Of course, this would be contingent upon the collected water being free of contamination as expected. (L)

1.d. Response

This will be addressed in the pre-design and design phase of the Remedial Action. The discharge will comply with state NPDES regulations.

2. Implementation Concerns

2.a. Comment

How long would the responsible parties be responsible for anything that might pop up, even after a thirty year period? (F)

2.a. Response

This varies on a case to case basis, but it is usually resolved by a cooperative agreement, or Consent Degree that will be established between the U.S. EPA and the Potentially Responsible Parties (PRPs). In some cases, monitoring may be done by the PRPs, the MDNR, or even, on a local level, by the Public Health Department.

2.b. Comment

How will the problem of subsidence and maintenance of the cap be dealt with? (E)

2.b. Response

The subsidence factor will be an important consideration in the Remedial design and action portion of the remedy. The design will take into account the settling of the cap that has occurred in the previous capping action. The cap will also be monitored and repaired when necessary.

2.c. Comment

Rather than fencing around the landfill, the county request that U.S. EPA consider planting trees, shrubs and other vegetation that will accomplish the purpose of restricting entry to the landfill. (H)

2.c. Response

The main purpose for installing a fence at the site is to protect the integrity of the cap by preventing pedestrian and vehicular traffic across it and to keep trespassers away from the gas vents. A "shrub fence" would not be as effective of a barrier as a chain link fence. However, alternatives to a chain link fence may still be discussed during the design stage of the project.

2.d. Comment

I would like to express my feelings about the closing of the landfill. I am a resident of the area and am in the process of buying a home at 5745 Iris Street. I feel very good about Alternative 4. I am satisfied that the recommenced solution, from what was said at the meeting at the Town Hall on August 17, 1988, is the best way to go. (J)

2.d. Response

Comment noted.

2.e. Comment

The Pere Marquette Township Board wishes to go on record recommending that Alternative 5 rather than Alternative 4 be implemented by the U.S. EPA, since it includes a groundwater collection system and an onsite water treatment plant. We feel very strongly that the groundwater contamination problem must be addressed and that Alternative 4 is an inadequate plan of action because it does not address the groundwater problem. (K)

2.e. Response

The U.S. EPA believes that more information regarding groundwater contamination is needed before a decision can be made on a groundwater remedial action, such as more information on the concentration of contaminants in the groundwater and on the relationship between the groundwater and the surface water. In addition, the effectiveness of the soil/clay cap of Alternative 4 must be measured before resources are expended on a pump and treat system. Testing indicates that the soil/clay cap will reduce the leachate generation within the landfill as much as ninety percent. This will in turn decrease the amount of contamination reaching the groundwater and therefore, in the future, contaminants in the groundwater may be dilute enough to fall below federal drinking water standards and acceptable risk levels.

By separating the remedial action at this site into two separate operable units, one addressing the landfill contents and one addressing the groundwater, the U.S. EPA can implement the remedial action for the landfill contents, a remedy that is consistent with the final remedy, while investigating the options needed to address the groundwater concerns. This is the most cost effective approach for the remedial action at the site.

2.f. Comment

Considering the known contamination of environmental media, the U.S. Fish and Wildlife Service recommends that selected organisms in Babbin Pond, Iris Creek, and associated wetlands be collected and analyzed as part of the monitoring program for the two operable units. This will permit the identification of actual risks to aquatic and wetland biota, and, if actual risks are found, provide a means to assess effectiveness of the selected remedial actions through the life of the monitoring program. The Service is willing to provide assistance in establishing this program to monitor biota. (L)

2.f. Response

Your recommended additions to our monitoring program will be taken into consideration during the development of the monitoring program established to assess the landfill contents operable unit and to further investigate the groundwater operable unit.

2.g. Comment

A limited number of surface water and sediment samples should be reanalyzed for the trivalent and hexavalent forms of chromium, so as to confirm the assumed predominance of the less toxic trivalent form. (L)

2.g. Response

Please see Response 2.f.

2.h. Comment

I am wondering if the consultant had a vested interest in future work being accomplished on this site and I ask, "does the investigative consultant proceed with the design of any remedial actions?" If this is the policy of the agency, that I believe that there exists an opportunity to unconsciously prejudice the report and its conclusions. While this may not be the case, I found the table which listed all of the organic contaminants found at the site impressive, but misleading, as ninety-five percent of the compounds listed were found in either soil samples or air samples from the existing methane vents.

These two sources were found to have assessment risks of $5x10^{-10}$ for soils and $2x10^{-7}$ to trespassers and not quantified or non-detectable to residences with 400 feet of the source of the bents. The listing of these contaminants was misleading without clarification of some kind. (N)

2.h. Response

Initially, the U.S. EPA offered the PRPs the opportunity to conduct the RI/FS, but since no agreement was reached, the U.S. EPA had its contractor conduct the studies. While the contractor conducted the investigation and compiled the RI/FS reports, the U.S. EPA in consultation with the Michigan Department of Natural Resources approved the work plans and the RI/FS report and selected the alternative to best remedy the problem following established criteria and guidelines.

The PRPs will have an opportunity to design and implement the chosen remedy if an agreement can be reached during RD/RA negotiations. If they decline it is possible that the same U.S. EPA contractor could be awarded the design and remedial action phases, although, usually, in the absence of a settlement with the PRPs, the Army Corps of Engineers conduct this phase.

In response to the comment on the table of contaminants, reports of industrial sludges and liquid wastes are documented in site project files. They are not highlighted other than to indicate past disposal practices at the site. Table 3-3 of the RI report is useful as a catalog of all contaminants found onsite and their respective media. The table reports the facts about the site. The interpretation of these facts is presented in the risk assessment.

3. Environmental Impact/Risk Assessment Concerns

3.a. Comment

What type of contaminants are in the landfill? How much of a threat are they to the aquifer? How persistent are they in both the aquifer layers and in the landfill, assuming we terminate the leachate with a cap? Is there direct contact between the aquifer layer and what is in the landfill now? (B)

3.a. Response

The wastes found are similar to those found in paint and plating wastes such as solvents (benzene and 1,1-dichloroethene) and heavy metals (lead, arsenic and chromium). Two contaminants, benzene and 1,1-dichloroethene, have been found in levels exceeding the drinking water standards in the upper aquifer near the landfill. The proposed landfill cap should decrease or eliminate these concentration levels.

Groundwater concerns will, however, be addressed after more investigation is performed. Based on historic aerial photographs, soil borings, and present water levels, we do not believe the waste is sitting within the aquifer.

The groundwater operable unit will address the drinking water standards, and the Applicable or Relevant and Appropriate Regulations (ARARs).

3.b. Comment

What will the cap do to prevent contamination of the springs in the area? (C)

3.b. Response

The cap addresses the downward percolation of the leachate; it does not address the lateral movement of the groundwater underneath it which flows to the north. However, since the cap will prevent leachate generation, and the springs are outside the immediate area anyway, there is no reason to expect them to be fed by anything other than just natural groundwater.

3.c. Comment

When you state that benzene and toluene are in the landfill, what are they contained in? Are they in drums, and if so, when these drums deteriorate, will a cap keep the chemicals from reaching the groundwater? (D)

3.c. Response

The records available for the landfill indicate that the industrial wastes were in the form of sludge or liquid that was disposed of in bulk within drying beds and later mixed with the refuse. The landfill cap in Alternative 4, with its drainage features, will alleviate the percolation of water through the landfill and the contaminated wastes whould therefore remain within the confines of the landfill.

3.d. Comment

The FS appears to take a rather limited view of the role of Executive Orders 11988 and 11990 and the Fish and Wildlife Coordination Act at the site. For example, the FS implies that only vegetated wetlands are covered under Executive Order 11990. The Service would classify Babbin Pond and Iris Creek as open-water wetlands and include these areas under the authority of the order. The Coordination Act is also interpreted to apply solely to modification of flows on Iris Creek. These statutes should be re-examined regarding their applicability to the site. (L)

3.d. Response

If Executive Orders 11988 and 11990 and the Fish and Wildlife Coordination Act are deemed relevant and appropriate for the Babbin Pond and/or Iris Creek wetlands, the regulations will be applied to the site.

3.e. Comment

At this time, we object to the remedial action proposed by the FS and the proposed Plan to the extend that the chosen alternative is inconsistent with CERCLA and other applicable laws or regulations, and further, to the extent that the alternative is not warranted by actual conditions at the site. (M)

3.e. Response

The U.S. EPA believes that Alternative 4 is consistent with CERCLA and other applicable laws and regulations. The groundwater contamination at and near the landfill and the presence of contaminants in excess of the Federal drinking water standards warrant CERCLA action. While Alternative 4 does not directly address the groundwater contamination, it is consistent with any final remedial action that will be implemented at the site. In addition, the presence of hazardous substances in the site requires a RCRA subtitle C landfill closure.

3.f. Comment

Part of the investigative work seemed either inconclusive or in need of further study. In particular, was the electromagnetic portion which only suggested possible plumes, the gamma ray logging of existing wells which was intended to confirm existing well logs, and the purge testing of the aquifer which gave values of the coefficients of transmissivity of between 20,066 gpd/foot and 348,654 gpd/foot. In my opinion, this range of values is not usable for aquifer characterization, or for conclusions to be based upon, although this information would be needed more for the remedial action of the groundwater than for the feasibility study. (N)

3.f. Response

The EM survey detected a zone of elevated electrical conductivity in the area directly north of the landfill. There is a buried metal pipe in this vicinity that may have caused the elevated readings. It is possible that a thin layer of clay, characteristic of the site's stratigraphy, could have caused the elevated conductivity. Since contaminants were detected in well MW07 which is located north of the landfill, the report concluded that there was a contaminant plume migrating to the north and northwest from the landfill.

Gamma log data corroborated the stratigraphy of existing logs (of wells that were not installed as part of the RI) and provided data for wells without recorded logs. Well logs were used to develop the site stratigraphy which was used to interpret aquifer characteristics.

Based on the information presented in Table B-1 of the FS report, the transmissivity of the upper aquifer ranges from 260 gpd/foot to 12,000 gpd/foot. The transmissivity depends both upon aquifer thickness and hydraulic conductivity, but the variation of hydraulic conductivities is responsible for most of the difference in transmissivities at this site. Hydraulic conductivities can and typically do range several orders of magnitude for different points within the same aquifer, and the data obtained in the RI fall within this range. For all calculations involving groundwater flow or groundwater collection, the range of hydraulic conductivities was used. This was intended to provide a reasonable range of contaminant migration velocities and groundwater collection rates. The sensitivity of the groundwater collection and treatment alternative to the range of collection rates was provided as part of the cost estimate in the FS.

3.h. Comment

The report identifies the various vehicles from which the public could come into contact with pollutants from the landfill and then assesses the risk of this contact by calculating the probability of a death caused by this exposure. A more complete discussion of Risk Assessment could have been accomplished so that the readers could understand risk assessment and its effect on what should or should not be accomplished as far as remedial action is concerned. From Table I-1 the following are summarized with comments:

VEHICLE FOR EXPOSURE

Drinking water off-site - The exposures for this category were determined from two sampling events of two residential wells off-site. In the first phase (Nov. 1986) detection of two organic compounds were found which gave a probability risk of $3x10^{-6}$ and $7x10^{-7}$. These two wells were replaced by deeper wells and the second phase of testing (Dec. 1987) found these and other organic compounds to be non-detectable and having a risk of zero. Recently, the EPA determined that, simply speaking, landfills should pose a health risk of no more than 1 in 10,000,000 or $1x10^{-7}$. It is seen from this that this vehicle for exposure is not a particular problem for this landfill in its existing geologic setting and is above EPA's published expectations for landfills.

Drinking water on-site - This vehicle assumes that a drinking water well will be placed on-site and used for potable water purposes. The risks for this occurrence are between $1x10^{-3}$ and $2x10^{-5}$ for the upper aquifer and $2x10^{-6}$ for the lower aquifer. These assessments are from Well No.7 which contained benzene and Well OWAI which contained 1,1-dichloroethane during the phase one testing. This is a real risk, one that cannot be ignored. However, it should be tempered with the knowledge that the chance of a well being drilled on site is nil. The County owns the site and understands the ramifications of a well being drilled. Intelligent use of deed restrictions would prevent a well from being drilled on this site. If a well is not drilled, then the risk is zero.

Surface water - Not quantified, no levels to report, and no risks. This vehicle is well beyond EPA standards and should become one of the most important yard sticks of determining a course of remedial action and to what degree the existing cap is to be addressed. (N)

3.h. Response

A complete discussion of the methodology, assumptions and results of the risk assessment, including numerous references to published documents, is provided in Appendix H of the RI report.

Existing residential wells downgradient of the landfill do not currently pose a health threat to receptors. Since contaminated wells were abandoned after Phase 1, the sampling point was not available in Phase II. The aquifer could still be contaminated at that location. The hydrogeologic setting of the site indicates that groundwater in the upper aquifer flows beneath the site to the north and northwest in the direction of off-site residential wells. Also, groundwater from the upper aquifer has a pathway to the lower aquifer. Trace levels of volatile organic compounds were detected in monitoring wells screened in the lower aquifer along Inman Road, and an excess lifetime cancer risk of 7×10^{-6} was determined. There is a potential for contaminants to migrate to off-site residential wells.

It is not possible to predict the future use of the site or ensure that drinking supply wells will not be installed on-site. The aquifer is contaminated above established federal and state limits, and future contaminant levels cannot be predicted.

Surface water bodies on or near the site are not considered to be sole indicators of groundwater contamination at the site. Much of the health risk that was determined for exposures to groundwater at the site results from the presence of volatile organic compounds (VOCs). These compounds volatilize upon contact with air. Thus, they would not be detected at concentrations that are representative of the groundwater after it discharges to the wetlands and Iris Creek. Also, all of the groundwater that flows beneath the landfill in the upper aquifer does not discharge to the wetland or Iris Creek. Rather, some groundwater migrates to the north and northwest, and some migrates to the lower aquifer.

3.i. Comment

Supposedly, the report does identify two separate operable units which need to be addressed and they are one; landfill contents and two; groundwater, on site. Based on results within the report, I believe that these conclusions should be questioned.

Based on computer modeling results presented in the RI report, it seems that the landfill contents are not a problem as a single source of contamination. Further, since the leachate discharges to surface water and the surface water risks are zero under current conditions, the landfill contents are not a risk. (N)

3.i. Response

The site was separated into the landfill contents and groundwater operable units because these are the two media onsite with contaminant levels high enough to threaten public health and the environment. Operable units for surface water, surface soils, and sediments were not included because risk associated with exposures to these media are low. Also, it is anticipated that remediation of the other operable units will reduce the contaminant levels of these media.

The computer analyses done in the RI used approximate and idealized models of the existing aquifer system. Assumptions of the models were presented in the RI report. Two models were investigated, one representing a slug of contamination, the other representing a continuous source of contamination. Based on the results of the analyses, it was concluded that a slug of contamination is not likely to cause exceedance of maximum contaminant levels (MCLs) or aquatic water quality criteria (AWQC). However, it was also concluded that continuous loading of small quantities of contaminants (2 x 10-3 to 7 x 10-4 gpd) to the groundwater could cause exceedances for MCLs and AWQC. The intent of the analyses was not to specifically predict or quantify aquifer contamination. Instead, it indicates that continual leaching of contaminants to the groundwater is more likely to cause problems in the aquifer than sudden releases.

Using the surface water to indicate groundwater contamination at the site was discussed in the previous comment. Surface water is not considered to be representative of the groundwater. Although the health risk associated with exposure to surface water are anticipated to be low, they are not quantified. This does not signify that such risk is zero.

Based on the data generated in the RI, the landfill contents are currently causing the aquifer to be contaminated to levels that exceed MCLs for benzene and 1,1 dichloroethene. For this reason, the landfill contents are a threat to public health and the environment.

3.j. Comment

The estimate of leachate generation should be reevaluated. The long-term ability of the drainage layer in the soil-clay cap to drain excess water is doubtful, and a surface layer cap would be more advantageous because of easier inspection and maintenance. (N)

3.j. Response

Leachate generation was estimated according to water balance procedures outlined in EPA guidance. The calculations and necessary assumptions are presented in Appendix A of the FS report. All three capping options (i.e. existing cap, regrading and revegetating, and soil-clay cap) were evaluated using the same runoff coefficients of 20% (summer) and 15% (winter). The runoff coefficient was selected based on surface slope and vegetative cover, form published data (Handbook of Applied Hydrology, Chou, 1964, p. 14-8). After visual examination of the existing cap it was estimated that runoff for existing conditions could be reduced about 25% because of landfill subsidence that has created ponded areas and loss of slope. The resulting water balance calculation gives an estimated infiltration of 5.2 inches/year. If the 25% reduction is not applied, the resulting infiltration would be 4.7 inches/year. This does not significantly change that percentage of reduction associated with each cap improvement.

The ability of the soil-clay cap at reducing infiltration is partially dependent on the drainage layer to remove water. Subsidence is a problem and the final design will have to take it into consideration. Slopes might need to be exaggerated to reduce the effect of subsidence, differential settlement could be monitored to indicate where subsidence is occurring (to indicate where maintenance may be needed), and different materials besides sand and drainage pipe might be need (e.g. geodrains).

3.k. Comment

I believe two questions should be asked and answered as simply as possible before proceeding with a remedial action project. First - is the affected aquifer (the upper) available now and in the future as a source for drinking water? The answer is no. And secondly - In this area is it economically feasible to locate a usable source of drinking water? The answer is yes, as documented by the re-drilling of two residential wells, mentioned earlier. Based on these answers, I do not believe that remedial action of the ground water is currently needed or apparent based upon the performance of the existing cap and the risk assessment given to the surface waters and off-site drinking water aquifers.

I also believe that the public can be protected by fencing this site, passing deed restrictions (if not already accomplished) and by continuing to monitor the site. I also feel that the cap should be maintained on a regular basis and believe that the MCDPW has the staff and experience to accomplish this function and suggest that a modified Alternative Number 2 be accomplished to that effect. (N)

3.k. Response

Even though there are no drinking water wells within the upper aquifer right at the landfill, a number of residents around the area still use the upper aquifer for their drinking water supply. Although no residential wells are presently contaminated, the potential for the contamination to migrate away from the landfill and to these residential wells is real.

It is economically feasible to utilize the deeper aquifer for an alternate drinking water supply, as some residents have done. However, the existing cap is not effective at reducing infiltration, contaminants are present in the aquifer immediately downgradient of the landfill and the potential exists for contaminants to migrate offsite. The RI report has shown that the upper aquifer does intermix with the deeper aquifer, so the potential does exist that if the contamination of the upper aquifer continues, the deeper aquifer also would become contaminated. To achieve the protection of human health and the environment, Alternative 4 was chosen as an interim remedy because it will secure the landfill contents better than the present landfill cap, and therefore help reduce the amount of contamination reaching the groundwater.

4. Funding concerns.

4.a. Comment

Who is going to pay for the clean up? (E)

4.a. Response

The Potentially Responsible Parties, PRPs, will be ultimately responsible. U.S. EPA will not, however, wait for the case to be settled if we can not negotiate an agreement. We will go ahead with the remedial action and attempt to recover the costs later.

4.b. Comment

The county recommends that EPA carefully review its estimates of the cost for remedial Alternative 4. The county believes that the cost estimates are unrealistically high. (H)

4.b. Response

The cost estimates are order-of-magnitude estimates with an expected accuracy of +50% to -30%. Cost estimating references and assumptions are presented in the FS report. The cost estimate is intended to help in the decision making process by estimating budget requirements for each alternative. If costs are inflated or deflated "across the board" for each alternative, the relative effect is minimal and the decision making process is not prejudiced.

4.c. Comment

The RI lists different PRP's than what the original summons did two years ago and I'd like to see that is properly addressed. (E)

4.c. Response

The PRP list at this time is the same as it was during the RI/FS negotiations two years ago. The RI report states that D&C Disposal is a PRP but they are not now considered a PRP, while Ed Dains, past site owner is considered a PRP, though even he is not listed in the RI report. If the county or any one else has information that indicates other PRP's, the U.S. EPA is willing to send information request letters to those parties if there is substantial evidence to warrant such a request.

5. Property value concerns.

5.a. Comment

We have a pond that is fed by Iris Creek, downstream from the landfill. Since around 1981, we have noticed deterioration of this pond and the loss of fish, can this be caused by the landfill, as several realty companies are suggesting? Can any sampling be done of my pond? Will this new cap help take care of our problem? (G)

5.a. Response

As noted in the RI report, Iris Creek was sampled and no significant contamination was found in downstream Iris Creek locations. Where as it is possible that past contamination from the landfill may have reached downstream locations, our surface water and sediment sampling does not suggest this. More investigations will be occurring to evaluate the groundwater effects to the surface water and to evaluate the effectiveness of the cap. This on-going investigation may be expanded to include points further downstream.

6. Notification period and response time concerns.

6.a. Comment

We (the governing bodies of the county) have been allowed only one month to respond and comment. It is almost impossible for a government to respond that quickly. Will you accept any comments after August 31? (E)

Mason County was not aware that the U.S. EPA intended to select remedial Alternative Number 4 until the public meeting on August 17, 1988. The county did not receive the final reports until about a week after the start of the public comment period on August 8, 1988. The 23 days total or 14 days from the public meeting, given to for public comment is not long enough for the county to review the documents and respond can more time be given for comments from the county? (H)

6.a. Response

The U.S. EPA is under Congressional deadlines and time limits to clean up Superfund sites. While we cannot accept comments after August 31, no comments will be ignored. It may be possible to work them into the design stage or further on in negotiations. We realize that it is very difficult for a municipality to respond quickly; this issue is being discussed currently in agency headquarters in Washington D.C. with the Municipal Settlement Group.

According to U.S. EPA record, Tim Hansen, Mason County Department of Public Works was sent a Final RI report on July 14, 1988 and a Public Comment FS report on August 5, 1988. The proposed plan was expressed mailed to Tim Hansen, on August 4, 1988. Also, all these documents were available for public review on or before August 8, 1988.

6.b. Comment

The public comment period on the Feasibility Study (FS) and proposed RAP was initiated on August 8, 1988 and expires on August 31, 1988, allowing only 21 days (15 working days) to provide written comments. The only apparent notice of the public comment period to Straits Steel as a PRP in this matter was provided by the EPA's August 24, 1988 letter (the "special Notice of Potential Liability"). This is clearly inadequate notice, coming well after the public comment period was initiated.

Given the complexity and importance of the issues involved, this short comment period does not provide sufficient time to thoroughly review the relevant materials and has unduly restricted our ability to comment on the appropriateness of the proposed alternatives. The lack of an adequate period to provide for thorough review and submission of comments may constitute a violation of due process. (M)

6.b. Response

The U.S. EPA, following NCP guidelines, has allowed 21 days for public comment. The FS report and the proposed plan. Actually, 23 days were available for public comment, August 8 through August 31, 1988. Appropriate notice was given announcing the public comment period and the EPA's preferred remedial action, as this was published in the local newspaper prior to August 8, 1988. Also, Mason County, the main contact throughout the RI/FS negotiations was informed of the timeframe for the public comment period. All appropriate documents were available for reviewing at the Ludington Library, Mason County Courthouse and at the Pere Marquette Township Hall, on or prior to the initiation of the public comment period on August 8, 1988.

6.c. Comment

We object to the initiation of the 60 day period of negotiation to establish a "good faith" proposal for implementing and conducting the remedial action as having been initiated too early. First, the Record of Decision

("ROD") to select the appropriate remedial action has not yet been issued. In the absence of a final decision on the remedial action, it is impossible for the PRPs to agree to "a detailed statement of work" identifying how they may proceed with the remedial action, or to meet the other elements which the U.S. EPA has indicated must be included in a "good faith" proposal. Second, while the U.S. EPA has prepared a list of six (6) PRPs, it is probable that other PRPs remain unidentified in connection with this municipal landfill. We fail to understand how the negotiations on a "good faith" proposal can proceed until all of the necessary parties are at the table. Accordingly, we request that the period of negotiation be extended to run 60 days from such time as the ROD has been issued and all PRPs have been identified. (M)

6.c. Response

The negotiation period for the Remedial Action routinely starts prior to the signing of the ROD so that by the time the PRPs arrange themselves into an organized group and review the pertinent documents, the ROD is well on its way toward finalization. By doing it this way EPA resources, as well as time, are conserved. With regard to obtaining more PRP's for this site, at the present time EPA does not have any other information indicating PRPs other than those that have already received special notice regarding RD/RA negotiation. U.S. EPA is willing to pursue other PRP's if the information provided indicates PRP involvement with hazardous substances being disposed of at this site.

APPENDIX A

List of Commenters on the Mason County Feasibility Study and Proposed Plan

Name	Affiliation	Source of Comment
(A) John Wolkow	Resident	8/17/88 Meeting
(B) Dave Cherba	Resident	8/17/88 Meeting
(C) George Cluchey	Resident	8/17/88 Meeting
(D) Kathy Winczewski	Resident	8/17/88 Meeting
(E) Tim Hansen	Mason County	8/17/88 Meeting
(F) Connie Anderson	Pere Marquette TWP	8/17/88 Meeting
(G) Mr & Mrs Robert Rasch	Resident	8/29/88 Letter
(H) Robert P.Tremp	Attorney representing Mason County	8/30/88 Letter
(I) Tim Hansen	Mason County	8/12/88 Phone Call and 8/17/88 Meeting
(J) Larry Gustafson	Resident	8/19/88 Letter
(K) Stanley Jansen/ Joanne Kelley	Pere Marquette Charter TWP Board	8/24/88 Letter
(L) Robert D. Pacific	U.S. Fish & Wildlife Service	8/29/88 Letter
(M) George B. Davis	Attorney representating Strains Steel & Wire Co.	8/31/88 Letter
(N) Dennis Dunlap	Westshore Engineering and Surveying Inc.	8/31/88 Letter